WORK

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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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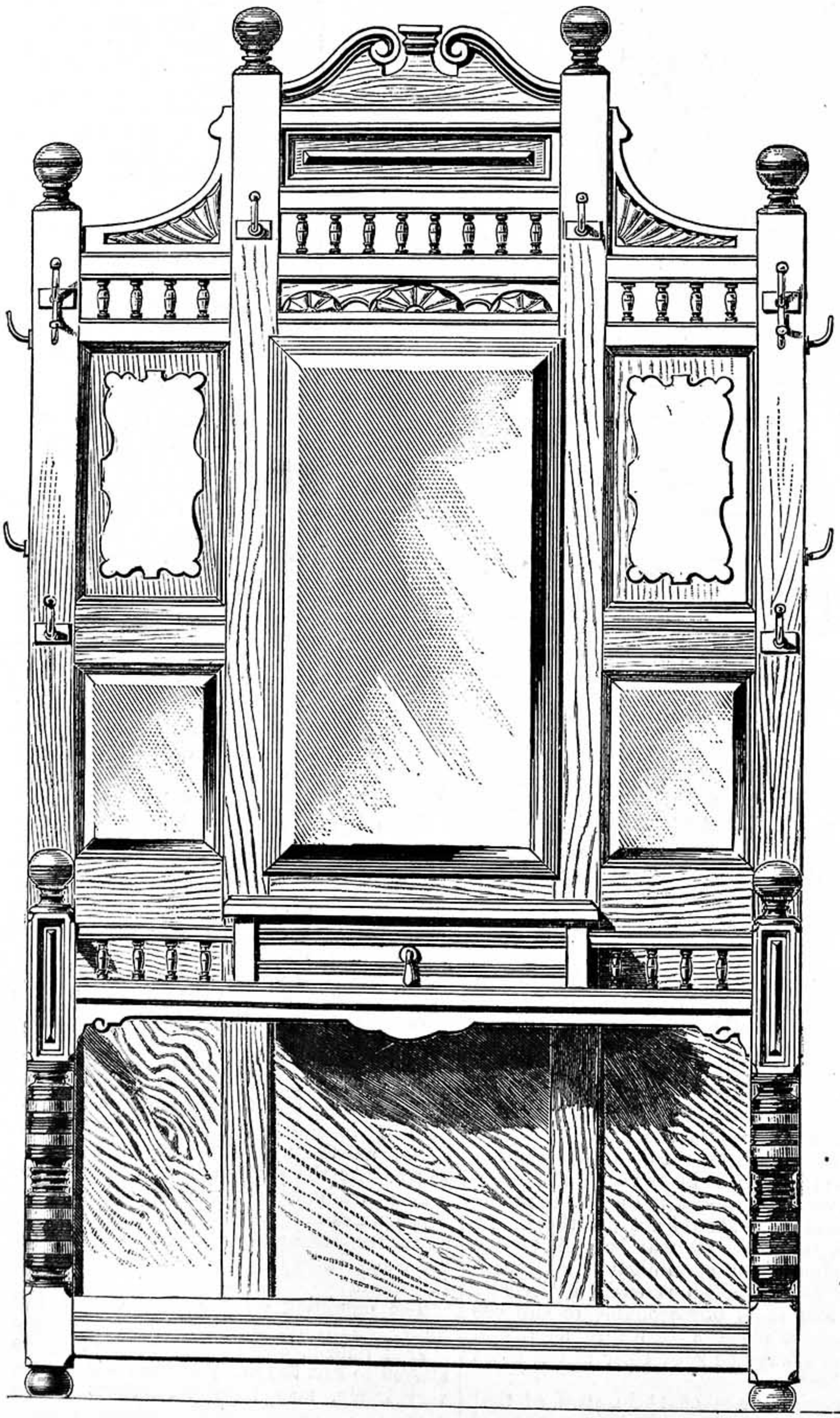


Fig. 1.—Hall Stand: Front Elevation.

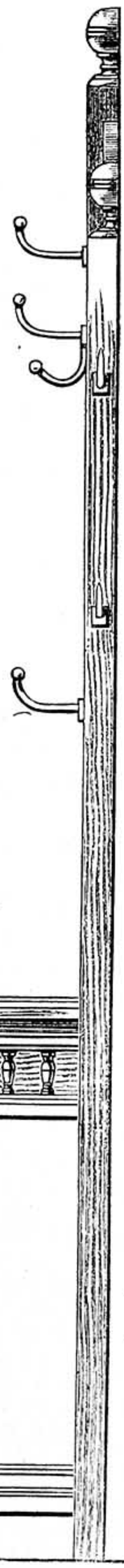
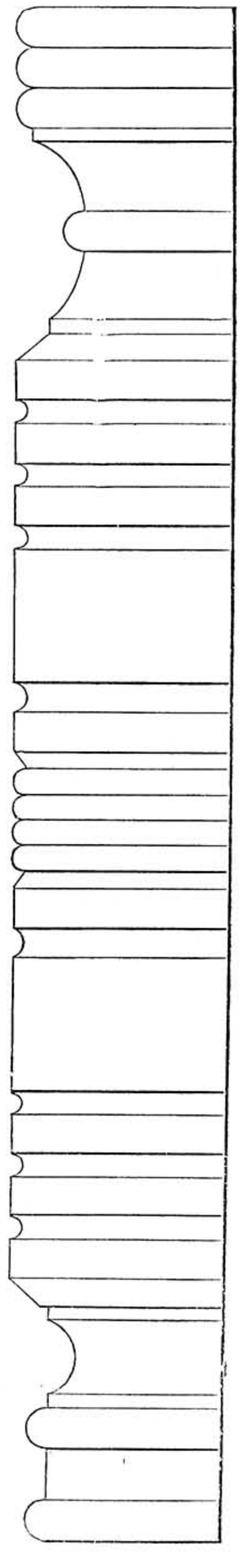
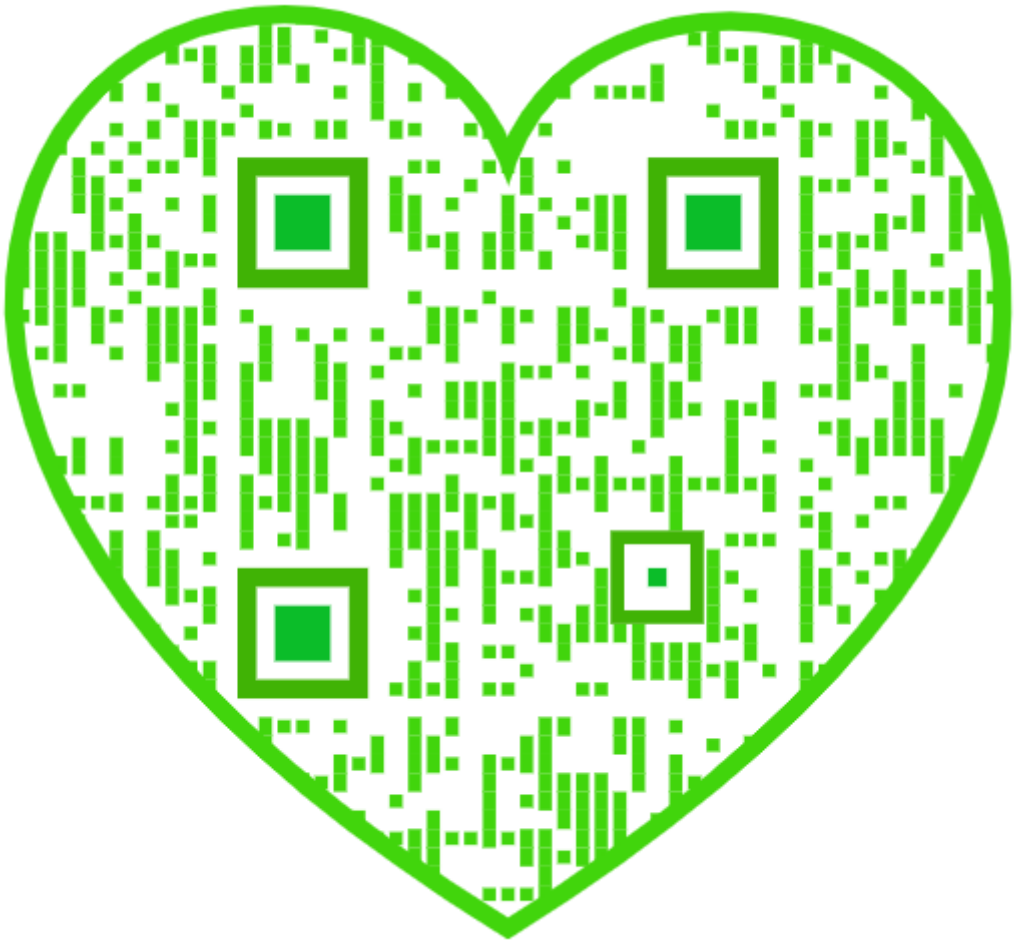


Fig. 2.—Side Elevation.

Fig. 5.—Turned Column, Half Length (full size).





MY HALL STAND, AND HOW IT IS MADE.

BY DAVID DENNING.

INTRODUCTION—MEASUREMENTS—CONSTRUCTION—WORKING DRAWING—MATERIALS—UPRIGHTS—CROSS RAILS—BEADINGS—TURNING AND MOULDING ON COLUMNS—MOULDING UNDER DRAWER—DRAWER BOX—BASE—PANS FOR UMBRELLAS—PANELS—BRASS WORK.

As the entrance hall of a house is the first part of the interior which is seen on opening the door, it is only natural that anyone who takes a pride in his surroundings should wish for a favourable impression to be created in the mind of the visitor by its contents. Unless the hall is of unusually large dimensions, the amount of furniture which can be placed in it is naturally very limited, and for all practical purposes may be said to be confined to the hat and umbrella stand, or, as it is often called, the hall stand. The hat stand may be separate from the umbrella stand, but when space allows, a much more important-looking piece of furniture results if the two are combined. It cannot be said that the stand which I have called "mine" presents any very novel features, either in its construction or its design. It is nothing but a good, substantial thing, not ugly, nor yet devoid of some pretensions to decorative effect. Probably it will be none the less welcome to readers because it, to some extent, follows the traditionary shape and arrangement of an ordinary hall stand, instead of consisting of various ingenious combinations or extraordinary lines. The construction is not difficult, nor need the cost be great, as there is no elaborate carving nor anything which an ordinarily skilful cabinet-maker cannot manage with his usual tools.

As the beginner would hardly attempt to make such a piece of furniture, it will be unnecessary to enter into a minute description of the details of construction so far as the manipulation of the wood and tools are concerned; while the accompanying illustrations almost supply the practised cabinet-maker with all the information he can require. To leave him without any description—or perhaps I should rather say without any hints—to guide him would not be altogether satisfactory to the majority, and the following remarks will, no doubt, be an assistance.

Fig. 1 gives the front and Fig. 2 the end elevation. As both of them are drawn to inch scale as nearly as possible, it will be seen that the outside measurements are as follows: height, 7 ft. 6 in.; width across front, 4 ft.; and depth from back to front, 1 ft. 2 in. It will thus be noticed that the stand is not a small one, although it is not unwieldy or cumbersome. Those who, for any reason, wish to make a smaller stand of similar design will have no difficulty in doing so, as it will only be necessary to take the design as it stands. and reduce the distances between the upright pieces. At the same time, it should be remembered that a very light small hall stand is not generally satisfactory, from its liability to fall forward when heavy coats are hung on it.

Leaving generalities, let us now examine the construction more in detail. We find all the essentials of a hall stand. There is a good-sized looking-glass, so arranged that a person of ordinary height can make use of it without stooping or standing on tiptoe. There is also a convenient table with drawer, and the spaces for umbrellas, sticks, etc., are large and get-at-able. The whole is sufficiently heavy to prevent the slightest risk of a mishap in the shape of an upset from any number of coats or other things which can reasonably be hung on it.

Although general measurements are given, the maker must on no account omit to prepare a full-sized working drawing from which to set out his stuff—as wood is generally spoken of among cabinet-makers.

American walnut is the wood of which the stand from which this description is taken is made, and it looks very well; there is, however, no reason why those who prefer oak or mahogany should not use them. In case oak be chosen, it may be well to say that it should not be fumigated and wax-polished, as the polish is easily injured by damp; and it is unreasonable to suppose that such a piece of furniture as a hall stand can always be kept clear of wet coats and umbrellas.

The uprights are of 1½ in. stuff, so that "down"—which, for the information of novices, may be explained as meaning finished after planing—they are about 1¼ in. thick. This may strike some who are accustomed to see that many London-made, and possibly other hall stands, are made much thicker, as being very thin when compared with these. It must be remembered that the wood to which reference is being made is solid, whereas in the unusually massive-looking stands the parts are generally found to be simply faced on the fronts and veneered on the edges. Of course, if the maker wishes he may go to the expense of thicker wood in the solid, or use facing with pine backing.

The cross-rails are, of course, the same thickness as the uprights. Those at the top, both in the centre and sides, are about 1½ in. wide, while those lower down are about 4 in. The bottom rail, to which the bottom of the stand is fastened, may be of any convenient width, and it is a matter of opinion whether it should project above the bottom board, and so form a small backguard, as in the illustration, or be below the bottom board. In the latter case it may as well be made of pine, as it is not seen.

It will be noted that the two longer uprights are fitted to the bottom rail, the ends of which are fitted to the end pieces. All the other rails are stopped by the uprights, for it would not be good construction for the rails to go right across and the uprights to be fitted into them. Whether the joints be dowelled or mortised and tenoned, is a matter of little consequence. The professional cabinet-maker will probably prefer the former, leaving the other and more tedious one to the amateur. It should be remembered that the centre rail below the glass must be considerably wider than any of the others, as it forms a back to the drawer box.

It will be noted that the edges of the narrower rails are beaded, and that the intermediate wider ones have beads run across them. These, of course, must be prepared before the rails are fastened in. The beadings are shown by Figs. 3 and 4, the latter of which, it may be stated here, is the same as on the drawer front, and the former as on the rails above the spindles in front and at the ends. These rails are of 1½ in. stuff, and about 2 in. wide.

The turning on the front columns, which are of 2½ in. square stuff, is shown full size, so far as the members are concerned, in Fig. 5. As the pattern is repeated for the lower part, only half the length is given. The squares of the columns are ornamented on the front and end, as represented in transverse section by Fig. 6, which gives the parts full-sized.

The moulding on the edge of the rail under the drawer is given in Fig. 7, but this—and, indeed, any of the others—may be altered to suit the fancy of the maker, who, very likely, may have preferences of his own.

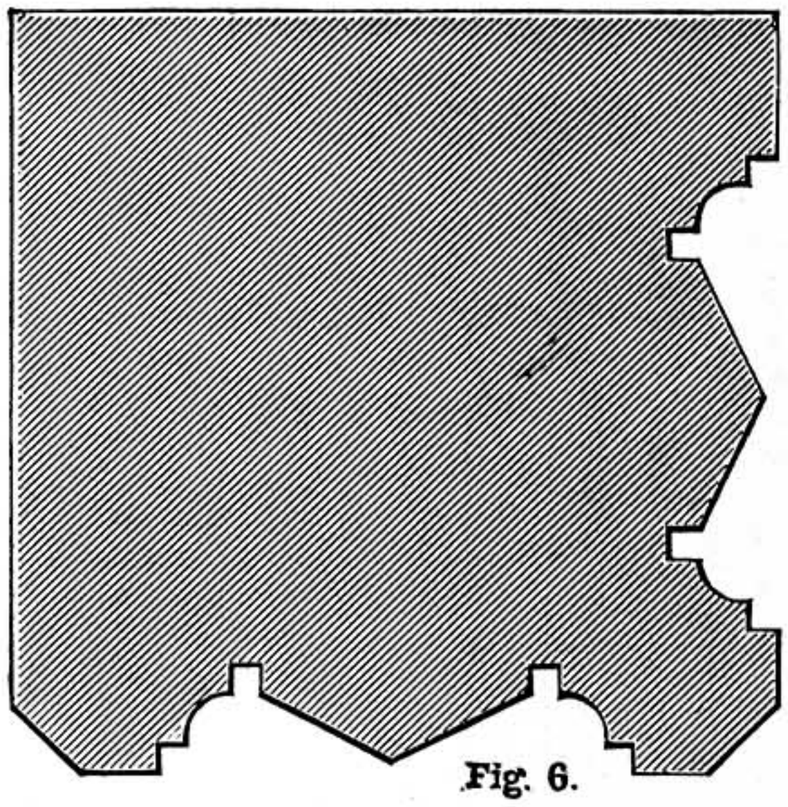


Fig. 6.

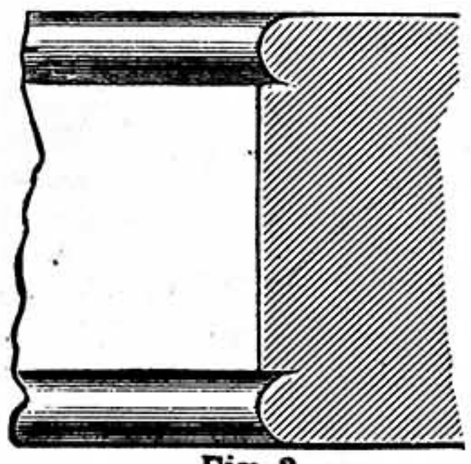


Fig. 3.

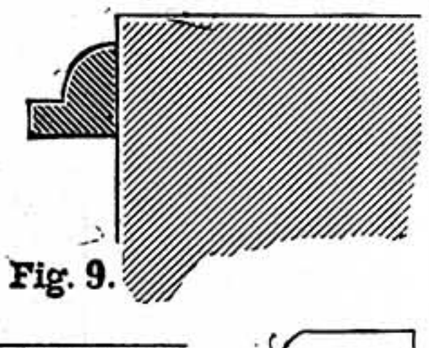


Fig. 9.

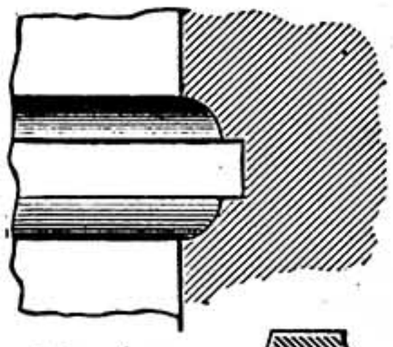


Fig. 4.

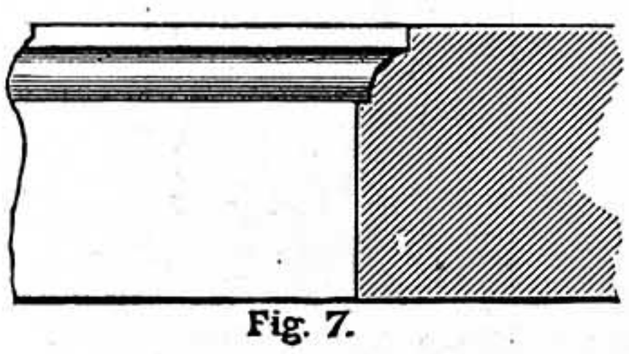


Fig. 7.

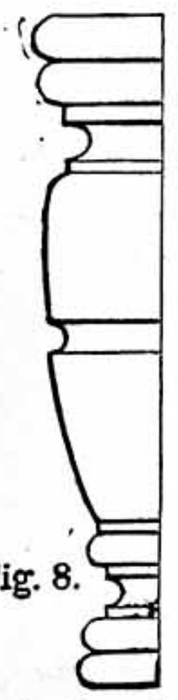


Fig. 8.

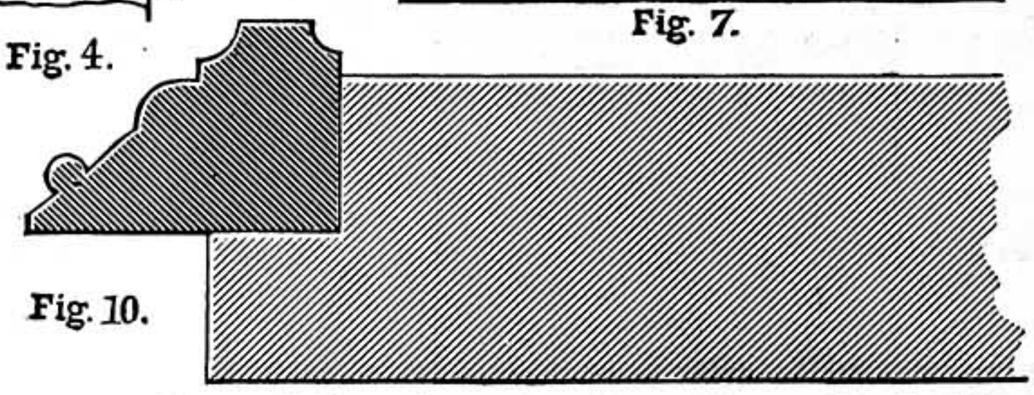


Fig. 10.

Fig. 3.—Beading on Rails. Fig. 4.—Beading on Drawer Front. Fig. 6.—Section of Square of Column. Fig. 7.—Moulding on Rail below Drawer. Fig. 8.—Turned Spindle. Fig. 9.—Panel Moulding. Fig. 10.—Moulding for Glass. All Figs. full size.

The same pattern of moulding is on the edge of the table top, which is screwed through from the back.

The ends of the drawer box are solid 1 in. stuff, and are fastened in the same manner to the back. Their bottom edges are on a level with the lower surface of the rail, under the drawer front. As the drawer and its fittings present no unusual feature, it may be presumed that it is unnecessary to say anything more about them. The fitting of the ornamental rail beneath presents no difficulty, and its shape is sufficiently shown in Fig. 1 to enable anyone to set it out.

The base will require some thought to be given it by those who are not familiar with similar constructions, though it is very simple. The front rail—viz., that which is visible in Fig. 1—is about 4 in. wide, of 1 in. stuff. The back one has already been referred to, so need not be mentioned further. As is well known, pans or tins are usually let into the bottom of umbrella stands, and this one is no exception to the general rule. They are, of course, where they will be most convenient, and that is under the open spaces on each side of the drawer. The whole of the bottom may be covered in, and holes subsequently be cut for the reception of the pans, but it is more convenient to have these of a good size than to have them so small as they sometimes are in stands otherwise well got up. The pans in this stand are, therefore, as big as they could be without being unsightly. They fill the space from back to front, and are practically square. Their edges rest on the front rail, on a ledge fastened to the back one, on the end rails, and on the board which encloses the remainder of the bottom. Now, the only part which is likely to trouble anyone is the end rail, for unless made as thick as the front columns, there will be a hitch somewhere, as the maker will soon find out for himself unless he is careful. To use such a piece as supposed would be only a waste of good material, so the way to do without it is to make the end rails say 1 in. less in depth than the front one, and then to make them equal to this by planting a piece of the necessary width on the top of them. The same object might be attained by making front and ends of the same width, and setting them back as far as possible. This method, however, would not look so well. In case anyone may want a pattern of the small spindles to turn to, Fig. 8 gives in full size all that is necessary.

The construction has now been sufficiently described, and all the rest to be done may be looked on as ornamentation, if we except the hooks, which, of course, are a necessity on any hall stand.

The lower panels above the umbrella spaces are plain, with sunk bevels. They are fastened in by mouldings of the pattern shown by Fig. 9, which gives the full-sized section. The same is used to the panels above, which are simply pieces of $\frac{1}{2}$ in. stuff, shaped as shown by the bow or fret saw. The carving on the panel above the glass and elsewhere is of the simplest kind. The moulding round the glass, as befits the most conspicuous part of the stand, is of a more elaborate character than the others. It is shown, also in full size, by Fig. 10. The fitting of the silvered plate calls for no special mention. Those who do not mind the trifling extra cost should have its edges bevelled.

The brass work consists of four coat hooks, two hat and coat hooks combined, and four single hat pegs, as well as a handle for the drawer.

We now come to an end of the hints for the construction of a combined hat, coat, and umbrella stand, with hall table, and if any beginner does not find them ample enough, let him remember that the job is not a suitable one for a novice, and that by the time he has acquired the manual skill necessary to make it, he will find that difficulties in the way of understanding the construction have vanished.

A USEFUL MICROSCOPE LAMP.

BY H. B. S.

ADVANTAGES OF LAMP — METHOD OF MAKING LAMP CHIMNEY OF TIN PLATE—METHOD OF MAKING SHADE—COST OF LAMP, CHIMNEY, AND SHADE.

FOR the benefit of readers of WORK who have a microscope, I will here describe a lamp and method of making which will, if followed, for a very small sum supply them with a useful article which would cost at least 15s. if bought of a dealer.

The fully-made article is seen in Fig. 1. The advantages of the lamp are: (1) That instead of the ordinary lamp chimney, a chimney of tin plate is substituted, in which is an ordinary 3 in. by 1 in. glass slip, or a slip of tinted glass of the same size; (2) the glass slip can easily be replaced, costing 4d. per dozen; (3) the glass slips do not break so easily with the heat as the glass chimneys; (4) the lamp is so low that, by tilting the microscope a little, direct light may be got from the lamp without reflecting the light by mirror.

Buy the lamp body—they cost $6\frac{1}{2}$d. in Liverpool. The wick stands about 3 in. from table. Then get a piece of tin plate, 6 in. by $5\frac{1}{2}$ in. (Fig. 2), and mark out an oblong by means of rule and steel point, commencing $\frac{3}{8}$ in. from side, of $2\frac{1}{2}$ in. by $1\frac{1}{4}$ in., then, by means of a cutting chisel, cut the piece out. Next prepare a strip of tin, $7\frac{3}{8}$ in. by 1 in. (Fig. 3). Rule right across it four lines, at $1\frac{1}{8}$ in., then at $2\frac{1}{2}$ in. from last, then at $1\frac{1}{8}$ in., and again at $2\frac{1}{2}$ in. Then rule right along one edge $\frac{1}{4}$ in. from side, and on the other side $\frac{1}{8}$ in. and at $\frac{1}{4}$ in., as shown. Bend the box into shape, after snipping at each of marks $\frac{1}{4}$ in. on each side. This will leave $\frac{1}{8}$ in. over at end, which requires soldering. Snip the box at top and bottom as shown (Fig. 3), so that the box will accommodate itself to the round shade. When this is done, push the box through hole in large sheet, bend up the $\frac{1}{4}$ in. as a flange, bore two holes on each side of the box through both sheet and flange, and rivet with copper rivets. Now bend the sheet on a round article, allowing about $\frac{1}{4}$ in. to wrap over, bore holes and rivet. The chimney will now be $1\frac{3}{4}$ in. in diameter, which will suit most lamps.

It will be found that the box will be thrown a little out of shape by bending the chimney into the round form, but this can easily be remedied by a few touches of the pliers. Now bend the top piece outwards $\frac{1}{4}$ in. as marked, the bottom piece outwards $\frac{1}{4}$ in., then inwards again for $\frac{1}{8}$ in., and the side pieces $\frac{1}{8}$ in. inwards, as shown in Fig 4. The box will then appear as in Fig. 4, and will allow of the glass slipping in from above, being held there by the side flanges.

All that remains is the making of the shade. This shade prevents the light of the lamp coming to the unoccupied eye. Cut out a piece of tin plate, $4\frac{1}{8}$ in. by $1\frac{1}{4}$ in., cut as in Fig. 5; this will allow $1\frac{1}{8}$ in. for top and $1\frac{1}{2}$ in. for each side. Snip at each mark to $\frac{1}{4}$ in., then bend into shape, and bend inwards each of the pieces snipped $\frac{1}{4}$ in.; this will then allow the shade to rest on glass slip, as shown in Fig. 1. The tin shade, being bright, is a good reflector, and a great deal of the light lost in every direction with glass chimney is now reflected and sent out in one direction; besides this, by using direct light from the lamp, a good light is got for high powers or for rather opaque objects.

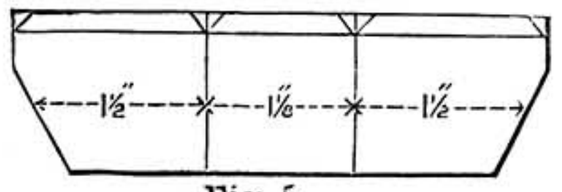
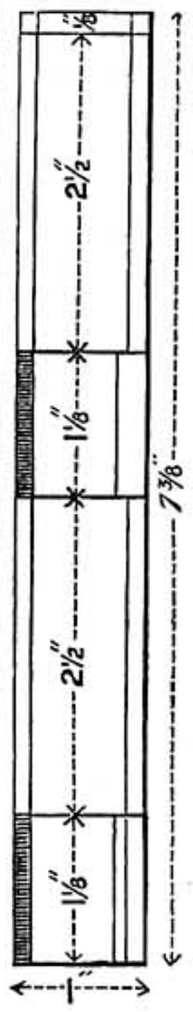


Fig. 5.

Fig. 3.



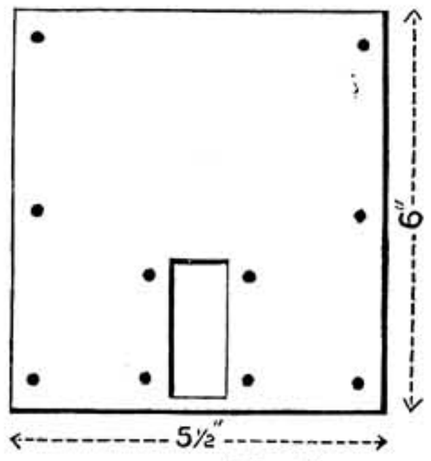


Fig. 2.

Fig. 4.

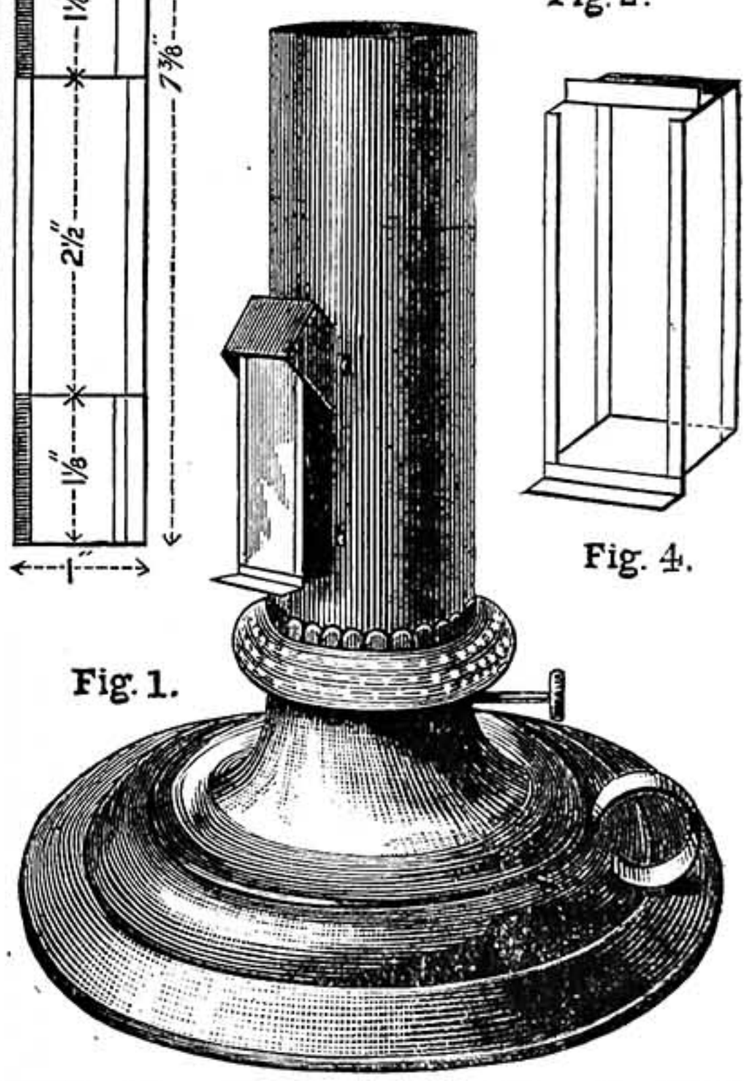


Fig. 1.

Fig. 1.—Microscope Lamp complete. Fig. 2.—Tin Plate to fit over Lamp Glass. Fig. 3.—Pattern of Template for Box. Fig. 4.—Box when bent into Shape. Fig. 5.—Hood or Shade for Box.

My lamp cost me (without tools): For lamp body, $6\frac{1}{2}$d.; for one sheet double-crown tin plate, 5d.; copper rivets, 2d. (per oz.); one glass slip, $\frac{1}{3}$d. Total, 1s. $1\frac{1}{2}$d. and $\frac{1}{3}$d. The glass slip has lasted quite a year, and is now as good as new. There are two friends of mine who have also made them, and they are as well pleased with their lamps as I am with mine. Finding this to be the case, it has occurred to me that others may find the lamp thus fitted and adapted for the purpose equally useful, and I have therefore placed on record in WORK the result of the experiences of myself and my friends, and the way in which we went to work; trusting that it may encourage and enable others to follow in the same path.

CONSTRUCTIVE STRENGTH IN METAL WORK.

BY J. WHITFIELD HARLAND.

MODES OF UNITING METALS—TENSILE AND COHESIVE STRENGTH—MANIPULATION OF IRON—PREPARATION OF STEEL—EXPANSION AND CONTRACTION OF METALS—ROLLING AND HAMMERING IRON PLATES—CONDUCTION OF ELECTRICITY IN WOOD AND METAL—ELASTICITY.

IN my hints in No. 76, Vol. II. of WORK, on "Constructive Strength in Woodwork," I pointed out that the very nature of wood itself demanded that the way of the grain, and the splitting tendency of it, should be taken into account.

In Metal Work there is no grain such as exists in wood, and metal does not split, but it cannot be held together by cement as wood is by glue; and whilst wood cannot be melted or heated, metals can be, and this gives rise to a totally different mode of construction.

Uniting metals may be done, firstly, by welding: *i.e.*, by heating almost to fusion two parts, and hammering them until they form one piece; secondly, by riveting; thirdly, by screwing or bolting; fourthly, by brazing or soldering; whilst the shape or form of pieces of metal may be altered, firstly, by forging; secondly, by stamping; thirdly, by melting and casting; fourthly, by rolling or bending.

In all construction, then, we must consider the reason for preferring one of these modes in any given case—that is, we must find out which of them is the strongest in relation to the purpose in view, and a few hints (for I only consider these papers as hints, and anything but an exhaustive treatise) in this direction may help WORK readers to think out for themselves, in their own way, and apply to their own work, such hints as may seem to them to have some bearing on the particular job.

Metals, like woods, have each their own tensile and cohesive strengths, as well as resistance to compression, from which their breaking strain can be ascertained. Tables are published of these strengths, and in construction, such as buildings, bridges, ships, etc., it is no longer safe to work merely as is done in carpenters', joiners', and cabinet work, with a knowledge of *where* strength is required; we must measure and estimate not only where strength is wanted, but how much strength is necessary. Human life is at stake in such work, and an error of judgment or a false calculation might produce a catastrophe causing agony and death to scores of people, besides making their relatives and survivors wretched, and often pauperising them. Such heavy responsibility as this should not be lightly undertaken, and demands the most conscientious care in design, in calculation and watchfulness, during its gradual completion, that no bad workmanship or faulty material creeps in to become a menacing danger.

By far the most useful and most used metal is iron, and it is of three distinct varieties—cast-iron, wrought-iron, and steel—which are none of them chemically pure, but are pure iron differently impregnated with carbon and other bodies. Thus cast iron contains the most carbon, steel less, and wrought-iron less still. By various processes cast-iron may be deprived of nearly all its carbon, and then becomes malleable or wrought-iron, or wrought-iron can be changed into steel by processes which add carbon to it: if too much carbon be not added, its malleability is not only not impaired, but improved, whilst if more than sufficient carbon be added its malleability is quite destroyed, and it becomes brittle, is much weakened in both tensile and cohesive strength, although its resistance to compression is not vitiated to the same proportionate extent. There is also a comparative degree of hardness in these three forms of the metal iron, owing to the presence, no doubt, of carbon. Cast-iron, whilst homogeneous, is granular in texture—I was about to say crystalline. Steel also is so to a less extent, partaking more of the fibrous structure of wrought-iron, though in an inferior degree; but it also possesses the property of being capable of excessive hardening, or tempering, as it is called: a property without which no tools for work could ever be made, and which all workers ought to regard as one of God's best gifts to man. Curiously, cast-iron with more carbon, and wrought-iron with far less, do not possess this property, except so far as their outer surfaces are concerned, which is termed, therefore, case-hardening. An instance of case-hardening is afforded by the Bower-Barff process, as it is termed, which consists in exposing cast-iron, wrought-iron, and even steel heated to redness to the action of steam (*i.e.*, the vapour of water). The effect of this is to convert to a slight depth the surface exposed into an oxide of iron, viz., the black or magnetic oxide (or peroxide of iron Fe_3O_4) which occurs also in a natural state, and is almost as hard as the diamond, and crystallises in cubes. It is useful, also, inasmuch as, being a higher oxide than the protoxide (*i.e.*, iron rust), iron so treated becomes rustless, resists the weaker acids and weak solutions of the stronger acids; thus it requires no painting, and is practically indestructible. It is called magnetic oxide, from the fact that natural loadstones consist of it. Cast-iron, if quickly cooled, especially in damp sand, where the heat of the metal when poured converts the moisture into steam, is almost converted in parts of its surface into this oxide (or perhaps, also, a silicate or aluminate combined with it), and the "skin," as it is termed, is extremely hard and brittle; but if the castings be annealed—that is, cooled very gradually—they are termed "malleable castings"—are fibrous rather than crystalline, and will bend rather than break.

Further, steel prepared by adding carbon to wrought-iron—especially when it has been subjected to a great deal of hammering, and more so still if made of wire, nails, or other small pieces welded into one mass—is far superior to steel made by partially burning, or otherwise getting rid of the excess of carbon in cast-iron. In other words, adding carbon to wrought-iron is better than taking carbon away from cast metal or "pig-iron." Bessemer steel partakes of the character of the latter process; Swedish steel of the former. Its tempering property is still further developed and improved by hammering—hence the best tools are those upon which the most labour has been expended, and therefore they are cheaper in the long run than low-priced ones. In a less degree, rolling adds to the value of both steel and wrought-iron—its action making both more fibrous, and therefore tougher.

In generalising thus, as I am doing, I must not omit to mention the fact that heated iron, steel, and cast-iron contract in cooling, although not to the same degree, probably, because the heat employed is much greater in the case of cast-iron than in forging—its contraction is greater. Steel also may be melted and cast, and then its contraction is also greater than forged or hammered steel. In order to obviate this contraction, which is unequal and by no means uniform, since it depends upon the rapidity of cooling in one direction being hastened or retarded by surrounding influences, Sir Joseph Whitworth successfully introduced the process of casting under compression, whereby the melted metal was compressed whilst heated to the extent required to prevent any further contraction as it cooled. Patterns, therefore, were made the exact size, instead of any allowance for contraction being made. That compression castings are immensely stronger than ordinary castings almost goes without saying, but if proof be needed, take a strap pulley or drum. The boss scarcely contracts at all—the arms, in proportion to their length, only about $\frac{3}{16}$ths of an inch to the foot; whilst the thin flat rim, six times the length of the arm, still contracts $\frac{3}{16}$ths of an inch to the foot. It stands to reason that there will always be a compressive strain upon the arms, due to the rim having contracted six times as much as the arm has done. But under compression the contraction is not in cooling, but whilst the metal is in a molten state, when its component particles are mobile, and can seek their own positions. How often, in turning drums or pulleys true on the face, do they break and fly to pieces—directly the "skin" is turned off, the rebound, so to speak, of the compressive strain on the arms overcomes the cohesion of the rim, and it gives way. Here let me remark that from its form the rim of a pulley will stand a far greater force from without than from within; a pipe, therefore, will burst from within far more easily than be crushed by pressure from without; nay, more, it is almost, not quite, as capable of resisting crushing from without as if it were solid throughout; and the crushing strain, if applied endwise, therefore, is practically the same as if it were solid; thus a hollow column will, if of correct proportions, bear as much weight as a solid column would—more, in fact, than the same weight of metal could sustain if made solid instead of tubular. This is due to the distribution of contending forces, whereby they neutralise each other's action. Hence we may safely deduce that form or shape contributes to the strength (as it also does to beauty, if thoughtfully used) of construction in metal. Take as a case in point a plate of iron $\frac{1}{4}$ in. thick, 3 in. wide, and 7 feet long. Support the extreme ends, and put on in the middle weight enough to break it. But if you dish such a plate—that is, form a corrugation lengthwise, say $\frac{1}{4}$ of an inch in depth—although the plate will be narrower, twice the previous breaking weight will be supported without danger. To consider the torsal or twisting strain: if the plate be flat, a very slight force applied in a contrary direction at each end will twist it easily; but if it be dished as described, such slight amount of force will have but little effect; it would remain practically rigid. In like manner, angle iron is almost as strong as a solid bar of the same breadth and depth, and far stronger than the same weight of iron rolled into a square or round bar; whilst T iron is for some positions, and under certain strains, stronger still. There is a still further gain: the weight of superincumbent iron is so much less for the same equivalent of resistance to strains—as in a roof, for instance—that the supporting walls or columns having less to carry may be so much, proportionally, weaker—hence an economy of material—without loss of

strength, whilst the labour in hoisting a less weight to the same height is also lessened. Further, if instead of *rolling* iron to such sections as I have alluded to, it were *hammered*, its strength would again be increased. The true explanation of these phenomenal facts lies in the great truth that all metals resist compressive strains much more easily than they do tensile, torsile, or side strains—just as I said there was a first principle in considering constructive strength in woodwork, but under different conditions. To illustrate this familiarly, a man can carry on his back or shoulders a far greater weight, when once it is raised for him, than he can lift from the ground.

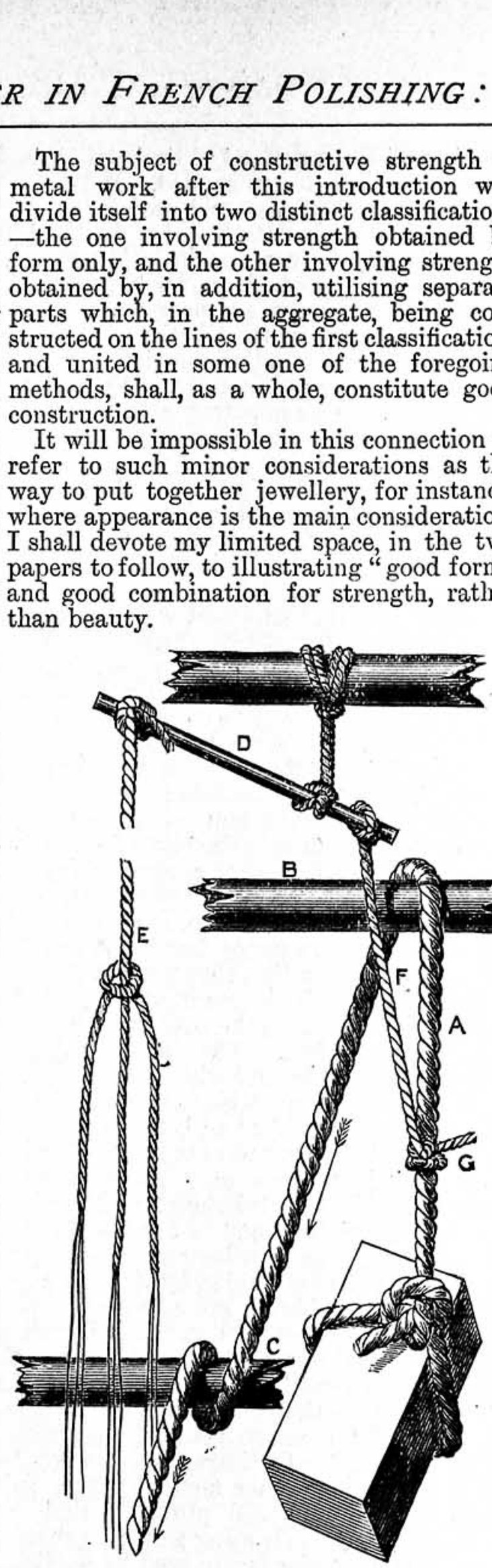
I ought not to omit another point of difference between wood and metal, and it is a very important difference—viz., that whilst wood never contracts in length, all metals do under the variations of temperature. Wood is affected not by mere temperature, but by moisture and light. Metal is, so far as is at present known, affected by heat alone. Light and damp apparently, though this is not proved, have no influence on its expansion or contraction, which probably is due to its greater density, or its homogeneous, instead of cellular, structure, which leaves no interstices for moisture to lodge in or light to permeate.

Another point of difference, which I fear has not been at all sufficiently investigated, but which offers a wide field for speculative scientists, is the different degrees of comparative conduction of electricity in wood and metal. We do know that cast or wrought-iron girders on railways when laid horizontally to carry traffic become less and less fibrous, and ultimately crystallise. Is this due to electricity, as I more than suspect, or to vibration, as some engineers maintain? Does vibration act direct, or does it, in some unknown and incomprehensible manner, generate or attract electricity? I cannot say, but I trust some day it may be elucidated. As in girder bridges, without such knowledge we cannot find any means of negativing its effect, because we do not know the cause. Take girders in subways, etc., for instance: if girders give way from this cause—*i.e.*, crystallisation—or from the constant action of rust, enhanced by sulphurous fumes emitted by locomotive engines and bad ventilation, "What price for shares?" Were I at the elbows of railway engineers, I would suggest that in replacing any girders the new ones should be previously made *rustless* by the Bower-Barff process, and that experiments be made, at no matter what cost, to determine what is the cause of crystallisation, and what is its remedy; and that a thorough inspection of all girders should at once be made on all the underground routes in the country. Unless this be done, no one will be less surprised than I to see an "extra special" newspaper detailing some catastrophe directly attributable to this cause.

There is one point of similarity between wood and metal that ought not to be lost sight of—viz., elasticity, a quality or attribute of both, differing only in degree. In some woods it is, as in some metals, nearly absent, as in lead and in cocoanut, where the elasticity is that of ivory, mere resilience, when struck. Steel, as a metal, possesses this attribute in the highest degree, as do lancewood, and yew, and hickory among woods. In metals, the greater the ductility the less the elasticity; and the reverse also holds good. Gold, the most ductile of metals next to lead, is absolutely inelastic. Now, elasticity is a force!

The subject of constructive strength in metal work after this introduction will divide itself into two distinct classifications—the one involving strength obtained by form only, and the other involving strength obtained by, in addition, utilising separate parts which, in the aggregate, being constructed on the lines of the first classification, and united in some one of the foregoing methods, shall, as a whole, constitute good construction.

It will be impossible in this connection to refer to such minor considerations as the way to put together jewellery, for instance, where appearance is the main consideration. I shall devote my limited space, in the two papers to follow, to illustrating "good form" and good combination for strength, rather than beauty.



Chinese Method of raising a Heavy Weight.

A CHINESE METHOD OF RAISING A HEAVY WEIGHT.

BY P. B. H.

THE annexed sketch illustrates the method at present in use in China for raising heavy weights in the construction of buildings, etc. Whether any readers of WORK will ever be brought into such a predicament as to have recourse to a similar method, time alone will show. It will, no doubt, be interesting, however, as an illustration of the antipathy this people has to anything new. Their method of procedure is as follows:—A good stout rope A is fastened round the object to be raised (in this case a stone is shown), and carried over a horizontal beam B, placed at some convenient height above the permanent resting place of the stone; it is then given a complete turn round a lower one C, and the end is dropped to the ground or some convenient platform, where it is held fast by one or more men, as required. This rope is principally for holding the weight after each rise, while the knot G is being readjusted. At a convenient height a lever D, about 25 ft. long, is hung suspended from a beam by a rope, which acts as a fulcrum about 4 ft. from the end. From the shorter end of the lever a rope is dropped and fastened by a running knot as low as possible on the main rope A. Another rope E at the longer end of lever falls to some convenient stage, where the end being unwound, as shown, each separate strand is grasped by one or several men, according to the power to be exerted. The ends of the rope E are now pulled, and the rope A is then raised, together with the weight, by the lever D, the men at the bottom end of A taking up any slack during the raising. This process is continually repeated, the running knot G being lowered, and the whole raised until the weight is at its destined height.

The above is a very good example of the use of the lever and friction, as very little force will be required at the lower end of the rope A to keep a heavy weight suspended, on account of the friction between the encircling rope and the beam C. This same frictional action is often seen when bringing up steamers at the landing-stage, and also on the rotating capstans used for shunting in railway sheds.

When we consider that such primitive means are still in use among the Chinese, who can be surprised that it is extremely hard to induce them to adopt railways?

There is thus, it will be seen, plenty of latitude for the persuasive powers of engineers and commercial travellers to induce them to use steam and machinery; but labour being no doubt so cheap, and the saying that "Time is money" not having yet been transplanted to the Chinese brain, there will be still some obstacles to overcome their prejudice. They are much worse than the natives of India in having anything instilled into them. These latter, when first the barrow was introduced, filled it about a quarter full, and then carried the whole on their heads. It was some considerable time before its proper use could be driven into them: so that it may still fall to some of our readers with strong persuasive qualities to make them abandon such methods, though I have no doubt the above arrangement would be useful in some parts of the world inaccessible to machinery.

THE RUBBER IN FRENCH POLISHING: HOW TO USE IT.

BY DAVID DENNING.

HOW TO MAKE THE RUBBER—THE OUTER COVERING—THE WADDING—PREVENTION OF CREASES IN COVERING—CHARGING WITH POLISH—MOTION OF RUBBER OVER WORK—RE-CHARGING—TOUCHING WITH OIL—PRESERVATION OF RUBBERS.

As is no doubt very well known, the pad by means of which French polish is applied is technically called the rubber. Without it the French polisher can do little or nothing in actual polishing, although he may not require it in the preliminary operations of oiling, staining, etc. However simple in itself the rubber may be, it is necessary that it should be properly and carefully made of suitable materials, for if it is not, really good work cannot be done with it. Possibly some readers who have seen polishers at work may be inclined to think that no great care is necessary, for all they saw was a dirty-looking rag covering a similarly uninviting-looking lump of wadding, or, as it is sometimes called, cotton wool.

Notwithstanding appearances being against it, the rubber, if in competent hands, will, on inquiry, be found to have been more carefully made than might have been expected, and the polisher would, in all probability, prefer it to any nice clean-looking rubber such as a novice would choose. Mind, it is not said that a dirty rubber is what is wanted, for dirt is fatal to really first-class work, and the polisher should keep his rubbers as clean as he possibly can. They naturally will get stained and discoloured with the polish, but that is a very different matter from being dirty. It may be news to some readers that old rubbers are preferable to new ones, provided that they have been properly taken care of and not allowed to get hard. The care of rubbers will be dealt with later on, and, in the meantime, their construction and general manipulation may be attended to.

For the outer covering or casing of the pad, soft rags are necessary. They may be either cotton or linen, the great point to be observed as essential to success being that they are perfectly soft. It should, perhaps, also be said that they must be tolerably fine, or, at any rate, free from knots or lumps. From this it will be seen that though rags have been mentioned as suitable, some care in their selection is necessary, and that it would never do to have a piece with a seam across it for a rubber, as anything which would tend to scratch the film of polish as it is being laid or worked on in the final operation of spiriting off must be carefully avoided. Some polishers advise the exclusive use of linen, but to confine oneself to this is a needless restriction. It must not be supposed, because rags have been mentioned, that new material may not be used. To render it suitable, however, it must be thoroughly washed to remove all traces of the sizing and stiffening with which it may have been finished. Of course, before it can be used for polishing it must be thoroughly well dried. This may seem a small point to urge, but it must be remembered that success in polishing depends to a great extent on the observance of details, and judging by the answers in the "Shop" columns, difficulties which would not occur to the experienced polisher are constantly cropping up. The necessity of avoiding damp (aqueous) cannot be too much insisted on. In addition to rags—of which not a very large quantity need be laid in, as in an ordinary household there is generally plenty of material available—some wadding will be required. This really is the rubber, as the rag is principally of use as a covering and to keep the wadding within proper bounds. White wadding is the best to use, and it is readily obtainable from any upholsterer or chemist; possibly it may be purer if got from the latter, and it is most certainly very much dearer than any reasonable upholsterer would charge for something equally suitable. Enough ought to be obtainable for a few pence to last a considerable time. If got from an upholsterer the wadding is sure to have a thin film or skin on one or both sides, according to whether it has been split or not. Anyhow, this skin must be removed, leaving nothing but the soft cotton. In cotton manufacturing districts, it may be useful to know that the raw material, if it is clean, will do equally as well as the finest wadding. The material known as cotton flock, and used by upholsterers as a stuffing for mattresses, chairs, etc., is not suitable, unless perhaps for the coarsest work. Even then it should not be used if anything better is available. For some special kinds of work rubbers composed entirely of flannel are occasionally recommended. It is, however, a matter of personal preference, and it is, to say the least, very doubtful if there is any advantage in using flannel, except sometimes, perhaps, for large flat surfaces, which can be got over more quickly with a large rubber than with a small one. All things considered, the novice cannot be advised to use any but the wadding rubber, and to become a competent polisher with it before experimenting with anything else.

To form a rubber it is only necessary to take a piece of the wadding and a piece of rag of sufficient size to enclose it. It is not enough, however, merely to wrap the wadding up anyhow, for it is absolutely necessary that on the bottom or sole of the rubber—*viz.*, that part of it which comes in contact with the work—there shall be no creases or folds. If there are any, then the delicate shellac film will be scratched. Perhaps the best way to convey the idea of what is wanted in a good rubber will be to imagine the wadding and rag ready to hand. Let a piece of the wadding be taken—say sufficient to form a ball, when moderately compressed, of double the size of a walnut. Put it in the centre of a piece of rag and gather up the edges of this so that the wadding is enclosed, as it were, in a bag. Keep the bag from opening by holding it with the thumb and finger tips, then press it down on any flat surface to flatten it, when, provided there are no creases, the rubber may be regarded as perfect. The whole thing is really very simple, and with a little care it will be almost impossible to make a mistake. The size of the rubber will, to some extent, naturally depend on the nature of the work, but that just given may be regarded as generally suitable. It is, however, impossible to lay down hard-and-fast rules in this respect, and the polisher, as he gains experience, must be guided by circumstances. Too large a rubber is not advisable at first. It has been mentioned incidentally above that the rubber is to be held by the tips of the thumb and fingers, but it must be understood that though this is the usual, because the most convenient, way with a rubber of moderate dimensions, the polisher may adopt any other method which suits him better. He will probably find, for example, that when using a large rubber it can be more conveniently used by holding it in the palm of the hand.

To use the rubber it must, of course, be charged with polish. Some care will have to be exercised in doing this, and to prevent mistakes it is well to say here that actual directions for completely preparing and polishing any article are not now being given. We are at present only concerned with the rubber, so that many points which it would otherwise be necessary to refer to may be disregarded with the assurance that they will be considered in due course. Some polish being handy, the covering of the rubber is to be opened so that a little polish can be dropped on the wadding. A convenient way of doing this is to have the polish in a bottle, the cork of which has a channel or notch cut in it to allow only a few drops at a time to escape. Some polishers dip the rubber, or rather a portion of it, into the polish, but then the novice must remember that an expert may venture on methods which a beginner should not attempt. The method recommended is the one generally adopted, so the learner will be under no disadvantage in following it. The wadding must by no means be saturated with polish, of which only enough should be used to moisten it and come through the rag covering when pressure is applied. The rubber having been charged, gather up the rag as already directed. Then, to equalise the polish, press the rubber moderately firmly into the palm of the other hand. The sole of the rubber ought now to be ready for application to the wood, which, for explanatory purposes, may be assumed to have been properly prepared to receive its first coating of polish. The principal thing at this stage, it must be recollected, is to get a good even body of polish on the wood, not thick in one place and thin in another, but distributed all over alike, and not too thickly anywhere. How this may best be done depends, to a certain extent, on circumstances, and on the custom to which the polisher has become habituated. One example must suffice, as, after all, if the desired result is got, the precise method is of secondary consequence. Let it be assumed that the work to be done is a small table top or other flat surface. With moderate pressure on the rubber, wipe quickly over the entire surface, first with, then across, the grain of the wood. Then proceed without delay to go over it more minutely, the motion generally adopted being shown in the accompanying illustration. The pressure should be gentle at first, but as the polish gets worked in and the

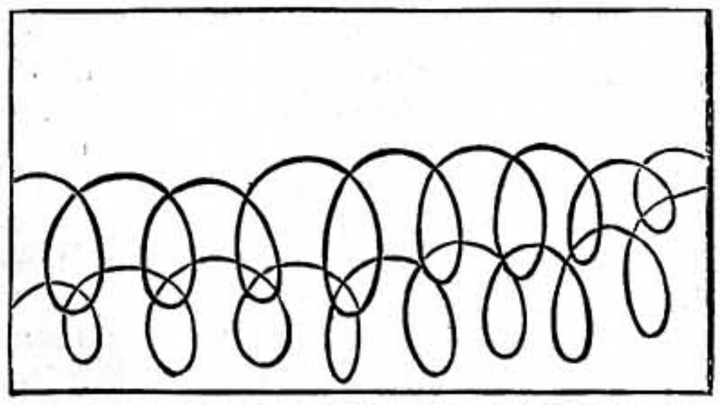


Diagram showing Movement of Rubber in French Polishing.

rubber drier, it is to be increased, though at no time must the pressure degenerate to mere scrubbing.

A very important point which it may be necessary to caution the novice about is the necessity of not allowing the rubber to remain stationary on any part of the work, and on no account ever to leave the rubber lying on it during temporary absence or at the end of the day's work. While the rubber is in contact with the wood it must be kept constantly in motion. As often as the rubber gets dry it must be recharged with polish, but let the novice beware of using this in excess.

When the rubber seems to stick, instead of moving pleasantly and sweetly over the wood, just touch the face of it with a little raw linseed oil. If the oil could be dispensed with altogether it would be better, but as it cannot be, the next best thing is to use it as sparingly as possible. The merest touch will suffice.

When any job is finished do not throw the rubber away, as amateurs have been known to do, under the impression that a rubber, when once laid aside, becomes useless. It does if left exposed to the air, because the spirit evaporates, leaving the shellac to harden. As old rubbers are better than new, when done with they should be kept in an air-tight receptacle; a tin canister or a biscuit box will do as well as anything. If they are laid aside for any length of time, they will even then become hard unless the box be perfectly air tight, which it probably will not be. A few drops of spirit put into the box now and then will, however, keep the contents in proper condition for use.

WIRE-WORK IN ALL ITS BRANCHES.

BY JAMES SCOTT.

THE WIRE GAUGE AND ITS VARIATIONS.

THE gauge is an instrument for determining the numerical size of any particular piece of wire. There are many different kinds of gauges, and, upon good authority, it is said that great variance exists amongst them. Fig. 4 is a drawing of the one I have seen mostly used. The decision, when ascertaining the size, is arrived at by placing the wire in the *notches* (the holes are merely for the sake of convenience), and the number of the notch into which it will exactly fit distinguishes the size by which the wire is recognised.

There is a little book, published by Messrs. Spon & Co., Charing Cross, London, written by Mr. Thomas Hughes, entitled, "The English Wire Gauge"—a book of which my opinion is that it would prove usefully acceptable to wire-drawers and wire-workers alike—in which are given over two dozen diagrams of distinctly different wire gauges, the originals of which, the author tells us, he has been collecting, and are of this and also last century's manufacture. Through the whole of his book he clamours for a standard gauge, on the grounds that at present the same sized notch on two or more different gauges is known by different numbers, thus frequently creating confusion.

I will take the liberty of making a few quotations from his handy little publication. In one part he says: "An order was received by cable from New York for . . . No. 36 W.G. (wire gauge). The receivers gave out the order No. 36 B.W.G. (Birmingham wire gauge), not aware of any other wire gauge. The manufacturers, incidentally learning what the . . . was for, instituted inquiries, and discovering it was for America, rightly concluded the gauge intended was Stub's, or Warrington wire gauge, that being the 'Birmingham wire gauge' commonly used in the United States. Had this order been executed in No. 36 B.W.G., the . . . would have been useless for the purpose intended. No. 36 on Stub's gauge is No. 44 on the 'Birmingham wire gauge,' and the difference in the price of . . . this order £28. . . ."

Mr. Hughes gives a drawing of what he proposes should be accepted and used as a "standard English wire gauge."

Although I have recommended his book to wire-drawers, I must tell them that in one portion he says: "Wire-drawers, as a body, are not the most intelligent of workmen; withal, they are too well aware of the fact that wire gauges vary, and are consequently content to draw their wire carelessly, irregular in size and form, knowing disputes cannot be settled by gauges." Whether this is fair or unfair to this section of workmen I will not venture an opinion. I trust it is not, for I have always been inclined to believe that the average British workman, whatsoever he laboureth at, is a painstaking individual. But Mr. Hughes gives his reasons for arriving at the above conclusions; and he also gives a brief but interesting history of wire-drawing.

He elsewhere says: — "Accurately drawn wire is daily becoming more and more incumbent upon manufacturers. Formerly good drawing was wire which would enter one notch, but not the next notch on the gauge to it, the limit of variation —say No. 1 wire— being the two-hundredth part of an inch. It mattered not whether the wire was round or oval." This is, undoubtedly, a fact, but I shall not endeavour to alter such circumstances, and therefore shall adopt the use of the gauge shown in Fig. 4, one which has been extensively used. Whenever I may mention certain sized wire in connection with any of the articles which I shall do my best to describe in following papers, it must be understood that I am using the numbers indicated upon the gauge just spoken of.

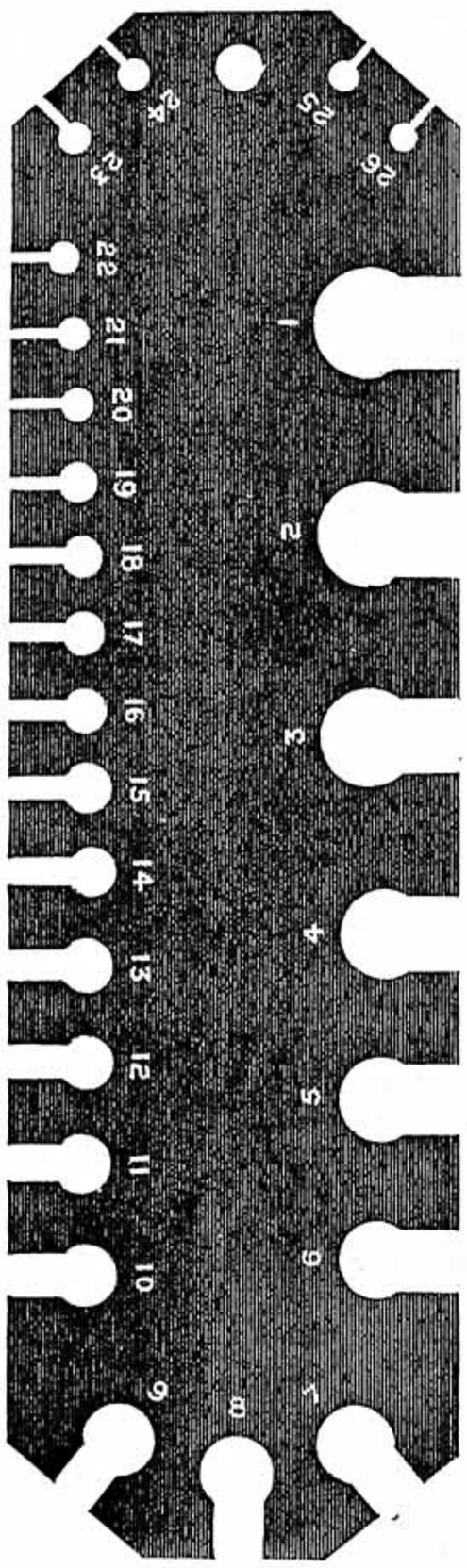


Fig. 4.—The Birmingham Wire Gauge (B.W.G.).

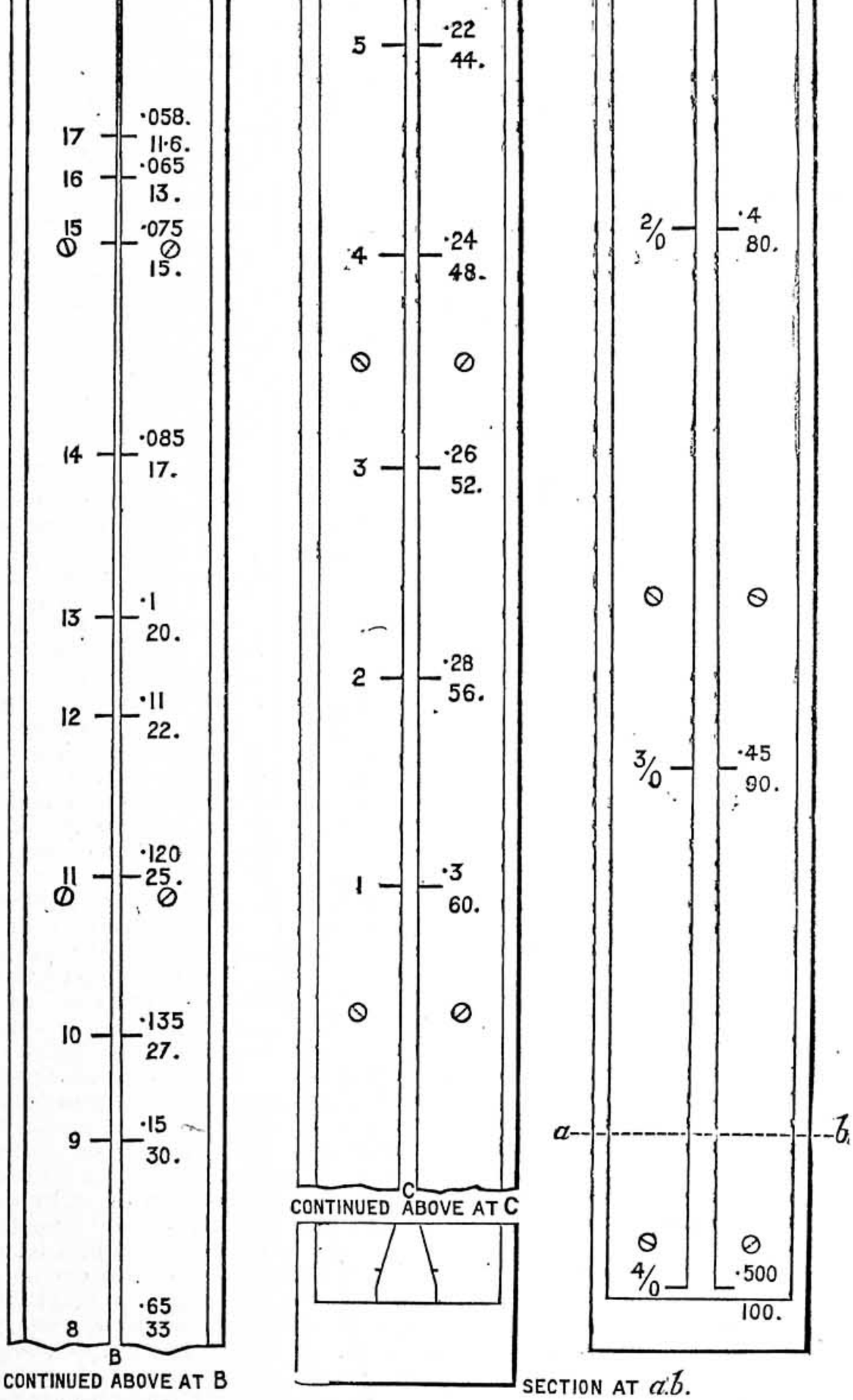


Fig. 4a.—Hughes' "English Standard Wire Gauge," slightly modified.

As wire increases in thickness, it is very often distinguished as *rods*; but it must not be assumed that I have taken any particular thickness as a starting point, for what in one workshop would be merely called wire would in another be termed rods. In reference to this Mr. Hughes says :—

"I have not found a wire gauge made anterior to 1846 to contain a larger size than No. 1, demonstrating that down to 1846 the largest size *wire* was No. 1. Anything larger was called *rods*."

I have alluded to wire-drawers, but it is not my intention—indeed, it is not within my power—to describe the process of wire-drawing. In fact, such really has no more to do with *wire-work* than the operations carried on in saw-mills have to do with what is generally known as *wood-work*. I give in Fig. 4A a diagram of "the English standard wire gauge," the invention of Mr. T. Hughes, reproduced, with slight alterations in the position of the figures, from his publication, "The English Wire Gauge." I cannot ascertain whether or not it has been adopted by many wire-drawers or workers, and would thank anyone acquainted with any firm using this gauge to announce the fact to me. I shall say nothing further upon the merits or demerits of the article than to remark that its length is a prominent impediment. I might suggest that, if made similarly, with graduated groove, but round—that is to say, its two ends almost meeting—it, perchance, would be an improvement. I am aware that there would then be an inner and an outer diameter formed by the groove, but I fail to see that this would materially affect its utility or accuracy. I reproduce the design here, knowing full well that it will be brought before numerous readers who may not have heard of Mr. Hughes's interesting book.

A TANGENT GALVANOMETER FOR WOOD-TURNERS.

BY H. A. MILES.

DESCRIPTION OF POST OFFICE TANGENT GALVANOMETER—HOW TO MAKE A SIMPLER, THOUGH EQUALLY EFFECTIVE, FORM—DESCRIPTION OF PARTS—HOW VARIOUS PORTIONS ARE CONNECTED—MATERIALS REQUIRED—METHOD OF PREPARING TURNED PARTS—LINING INSIDE OF INDEX BOX WITH TINFOIL—GLASS REQUIRED—USE OF MIRROR—DRILLING NECESSARY—DIVISION OF INDEX—PREFERABLE ALTERNATIVE — PIVOTING OF MAGNET — SUSPENDING SAME BY SILK THREAD — NEEDLE — BEST LENGTH — INDICATOR — WINDING OF COILS—GAUGES OF WIRE TO BE USED—CONNECTIONS OF COILS ON BASE—USE OF SHORT CIRCUITING KEY—LEVELLING SCREWS—HOW MADE—USE OF THE INSTRUMENT — EXAMPLE — SHUNTING PART OF CURRENT—CONCLUSION.

THERE is always a demand amongst amateur wood-turners for designs of simple articles which are effective in appearance, and yet do not require an extraordinary degree of manipulative skill in their construction. I therefore propose to show how a turner of average, or even limited, ability may make a handsome article at a very small cost.

Those who have studied electricity will not require to be told the use of a tangent galvanometer, which is a costly though beautiful instrument. Those used in the post office, for instance, which are of the best design, are all of brass, with adjustable controlling magnet, micrometer levelling screws, etc., and are so arranged that the upper portion may move through an arc of a circle independently of the stand.

The instrument I shall describe was designed for the use of electrical engineering students who wished to construct their own apparatus, and was made of mahogany.

Fig. 1 is a front elevation of the completed instrument. A is the ring which contains the coils of wire; B is the box in which the index plate and magnet are placed; C is its support; D the support for the ring and box; and E the base.

Fig. 2 is a section of Fig. 1, and shows the manner in which the various portions are fixed together.

The mahogany required will be a piece 1 in. in thickness, sawn roughly to a circle $9\frac{1}{2}$ in. in diameter. A circle 2 in. in thickness and 6 in. in diameter, another $1\frac{1}{2}$ in. in thickness and $9\frac{1}{2}$ in. in diameter, about 6 in. of 3 in. square, and a few odd pieces of small size.

To commence, fasten the piece of 1 in. stuff on the taper screw chuck, and face up one side. Reverse it, and then true up the other side for a couple of inches from the outside, and cut the groove for the wires—$\frac{1}{2}$ in. wide by $\frac{5}{8}$ in. deep—on its periphery. The edges of the flanges should now be neatly rounded and papered up on both sides, after which the ring may be cut off with a parting tool, the inside dimensions being 7 in. The inner edges will probably be slightly rough, and may be papered off by hand, or a piece of stuff may be chucked, and a recess turned on its face, into which the ring fits, friction tight, a little chalk being used to prevent any slight slipping. All being now finished, it should be put away till wanted for polishing.

The piece left on the chuck must also be put aside, as it will be utilised in making the cap for the index box.

This may now be commenced. The 2 in. stuff should be chucked and faced up, leaving it of the shape shown in the section. The projecting portion being 2 in. in diameter by $\frac{1}{4}$ in. in depth, this side must now be chucked and the stuff turned down to a diameter of $5\frac{1}{2}$ in. The inside may now be removed to a depth of $1\frac{1}{2}$ in., leaving the bottom $\frac{1}{4}$ in. thick. The bottom may have a small bead run round, and the edge of the box must be rebated to take the cap, as shown in Fig. 2.

Now remove the box from the chuck, and replace the disc from which the ring was cut. This must be turned down so that the box will fit easily and yet not loosely, the rebate being of sufficient depth to allow for the thickness of the glass. The outside may be roughed into shape and the cap cut off, when the box must be rechucked, the cap fitted on with a little chalk, and neatly finished off with glass-paper.

The projection on the bottom should now be partly cut away, as to leave a tapering dovetail, which fits into a corresponding mortice in its support.

Before proceeding with the box support, etc., it would, perhaps, be advisable to turn up the base, and then work upwards. The base, which is of $1\frac{1}{2}$ in. stuff in the rough, should be faced up true on one side, reversed, and the edge of the other side trued up, and the middle recessed $\frac{1}{4}$ in. deep to within 1 in. of the edges. A bold moulding should now be turned on its circumference. A parting tool cutting a hole in the centre about 1 in. diameter will now remove it from the chuck.

The ring support, D, should next be done up, being made from 3 in. stuff. The bottom should be turned to fit the centre hole in the base, and a $\frac{1}{4}$ in. hole bored right through for the passage of the wires connecting the coils with the terminals in the base. A slot must now be carefully cut with a fine saw, into which the ring must tightly fit. The ring should now be marked, so as to be able to replace it in its exact position again; care being taken that the grain of the wood is either horizontal or vertical, the former, to my mind, having the best appearance. A $\frac{1}{4}$ in. hole must now be cut in the portion of the ring which fits in the slot, and the base of the box support turned so as to "cap" the other one, and fit into the hole in the ring by means of a projecting pin—the top being fitted with a dovetailed recess as shown in perspective in Fig. 3, corresponding to the dovetail left on the under surface of the index box.

The woodwork is now complete, and should be nicely polished; the interior of the index box should, however, be left plain, its sides subsequently being covered with tinfoil neatly glued all round to reflect the light on to the index plate.

If the galvanometer is to be fitted with levelling screws, three will be required, and I shall refer to this at a future stage; but if not, three small knobs should be turned up, all exactly the same thickness, and glued in their places underneath, as shown in Fig. 2, the pins fitting into the holes bored for their reception.

The wood-turner's portion is now finished, and he may survey with pardonable pride the neat appearance his work will present if it has been conscientiously done, and the directions given have been properly followed.

The next stage will be to get a piece of looking-glass to fit inside the index box, and a piece of plain glass to fit *on* its edge inside the cap, the latter maintaining it in position. A small hole should be drilled in the centre of each.

The division of the scales on the index is a matter requiring great accuracy, and a deal of trouble would be saved by taking a walk yourself, or sending that convenient acquisition, a young brother, to the nearest newsvendor's, there purchasing a duplicate of this number of WORK, and cutting out the index, which may then be fastened to the looking-glass, using paste and glue. When dry, the two portions marked × may be cut round with a sharp knife, and carefully removed. For those who would prefer to make the scales themselves, I have shown the means of obtaining the tangent divisions (Fig. 4). The use of the mirror is to prevent errors due to parallax, as if the eye is exactly over the needle its reflection on the glass will not be visible.

The important question has now to be decided as to whether the magnet and pointer shall be balanced on a pivot, or suspended by a cocoon thread. I need hardly say that the former is vastly superior to the latter, though proportionately more difficult. If it is decided to suspend the needle, the silk thread is secured in the hole in the glass cover by a little shellac, and the needle fastened to its other extremity as near as possible to the index.

I shall, however, take it for granted that the larger proportion of my readers will prefer to pivot it properly, and make a good job of it.

A sewing needle driven upwards through the bottom of the box so as to project about $\frac{1}{4}$ in. through the centre hole in the mirror will make a splendid pivot. The surplus part underneath may be broken off out of the way.

The needle now claims attention. It may with safety be made $\frac{3}{4}$ in. long without introducing any perceptible source of error considering the diameter of the coil, and should be about $\frac{3}{16}$ in. wide and $\frac{3}{32}$ in. thick.

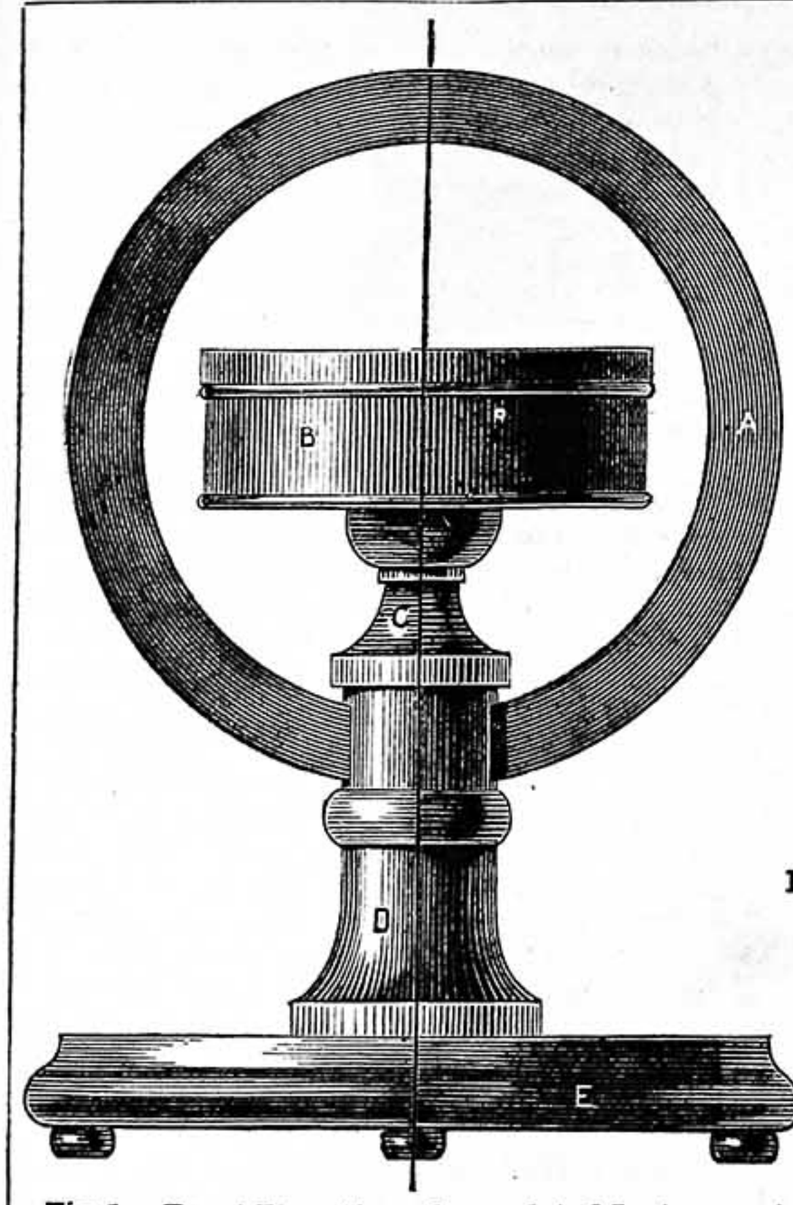
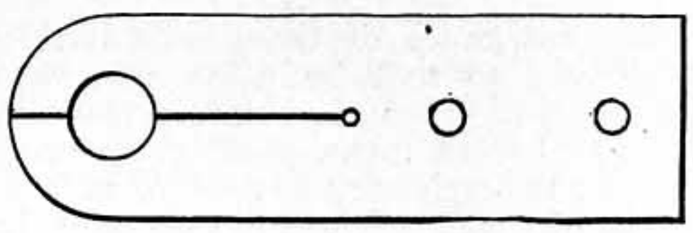


Fig. 1.—Front Elevation of completed Instrument.



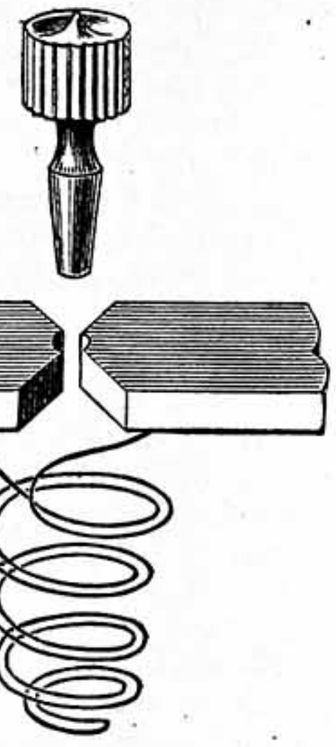


Fig. 7.—Levelling Screw.

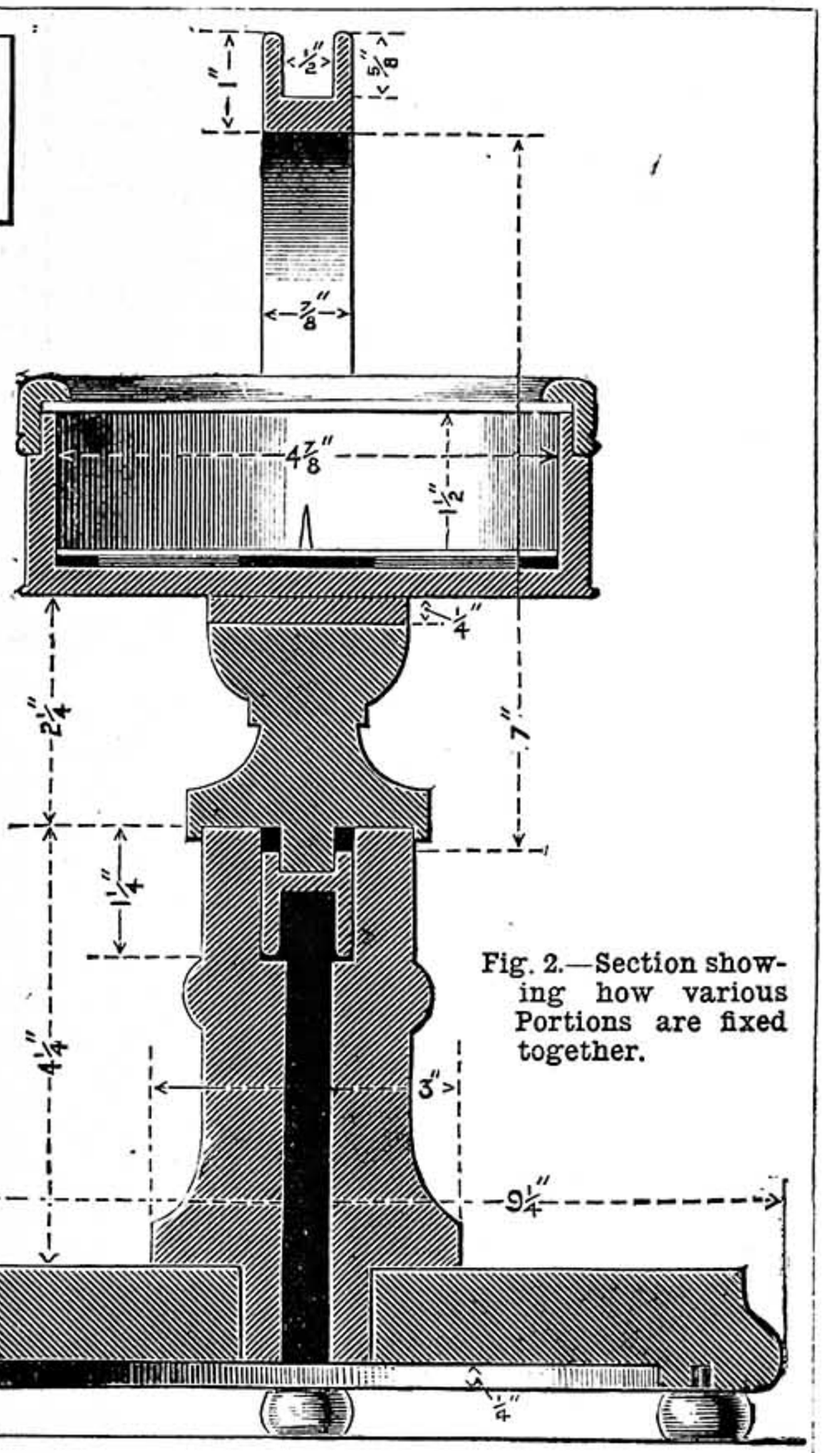


Fig. 2.—Section showing how various Portions are fixed together.

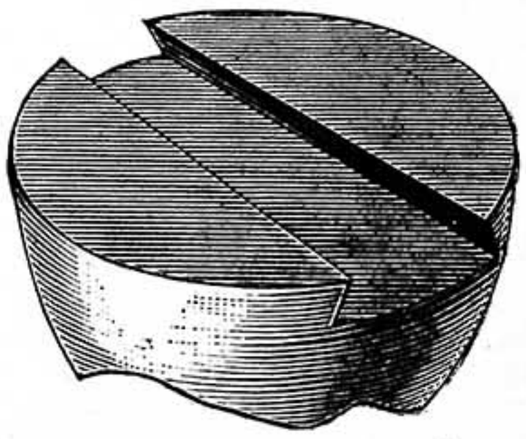


Fig. 3.—Dovetailed Recess in Top.

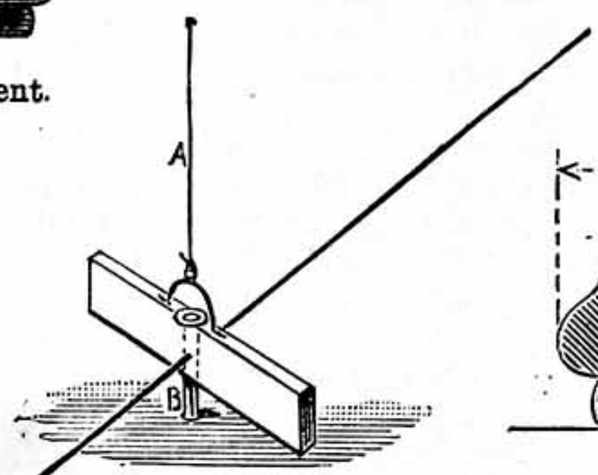


Fig. 5.—Alternative Methods of fixing Needle.

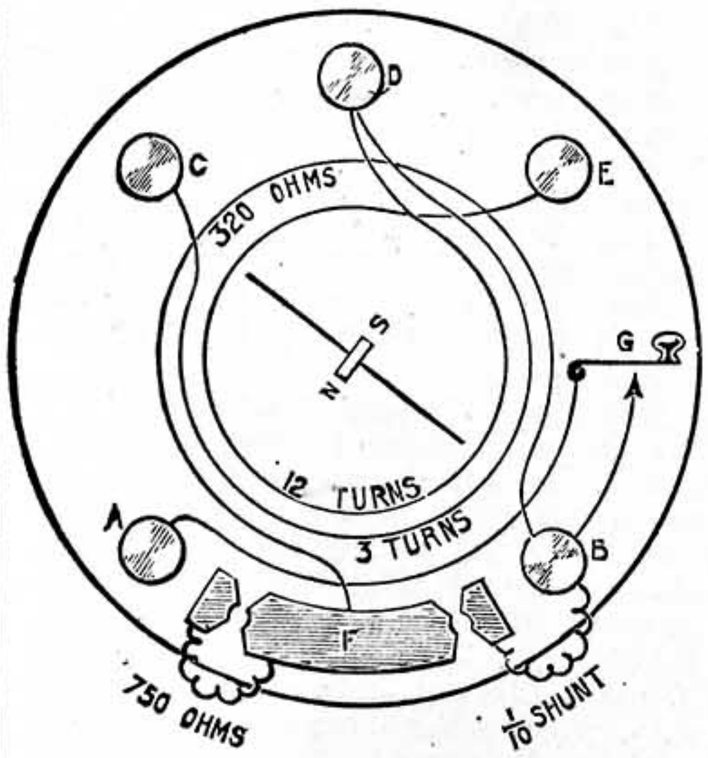


Fig. 6.—Resistance Blocks, Terminals, Wires, etc.

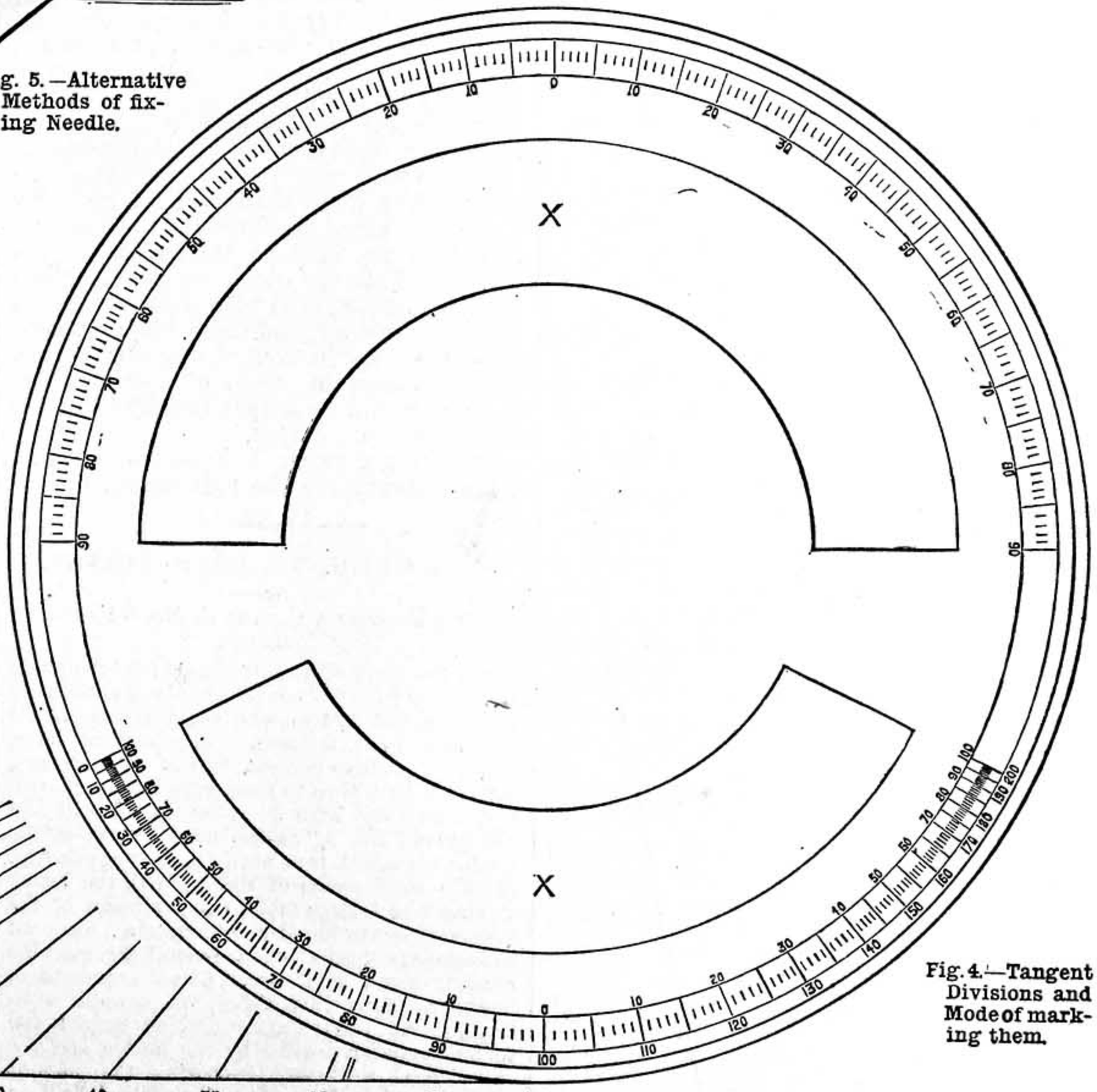
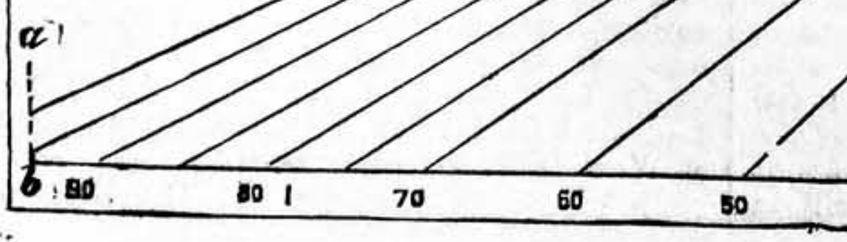


Fig. 4.—Tangent Divisions and Mode of marking them.

Fig. 4a.—Continuation of Fig. 4 to Left Hand.



A hole should be drilled through the centre across the $\frac{3}{16}$ in. width, sufficiently large to allow the sewing needle to pass freely through. The needle should pivot on a jewel, as it is absolutely necessary to eliminate all possible friction. A jewel set in a small plate can be obtained at the watchmaker's, and fastened immediately over the hole by a little solder or shellac. A piece of very fine but hardened copper wire must now be fastened to the piece of steel, so as to form a straight line at right angles to it, and of sufficient length to reach the width of the index card. This pointer is the means employed to read the deflections shown on the scale. The accuracy of the pointer may be tested by observing whether its two points correspond to the zero on each side of the scale.

Fig. 5 shows the alternative methods of fitting the needle: A showing the silk thread means of suspension, and B the sewing needle pivot.

The winding of the coils may now be proceeded with, and wire of the following gauges, best quality, should be used.

Between the centre of the resistance blocks and the terminal B, No. 36 silk-covered copper wire of sufficent length to offer a resistance of 320^w should be used; something over $\frac{1}{2}$ lb. will be required.

Between C and D, three turns, and between D and E, twelve turns, of No. 18 silk-covered copper wire, the three turns being wound in the opposite direction to the twelve turns.

The resistances inserted between the brass blocks are made up of No. 38 German silver wire, wound on a shallow reel under the base, the wire being doubled in half before being wound, as shown in Fig. 7.

The wires are neatly wound in the ring and passed through the hollow pillar and out below the base, where they are connected to the various terminals, as shown in Fig. 6.

When this has been done, a strip of patent leather may be fastened over them, so as to give a neat finish to the coil.

The small key shown at G, in Fig. 6, is for the purpose of checking the oscillations of the needle, and bringing it quickly to rest, the coils being short-circuited when the key is depressed.

Levelling screws, if required, may be made in the following manner—

Three pieces of rolled brass, $\frac{1}{4}$ in. by $\frac{5}{8}$ in., and 2 in. in length, may be neatly filed up, one end of each being rounded to a semi-circle, as shown in Fig. 7, where also is seen the positions of the holes to be drilled. The hole at the rounded end should be tapped to take a convenient-sized thread, say $\frac{1}{4}$ in. Whitworth, though a fine instrument thread is far preferable. The end may now be sawn down for a short distance, and the ends slightly closed by a light tap with a mallet (to save denting the metal), so as to give a spring grip upon the screw. The two small holes at the other end are for the purpose of screwing it to the under side of the wooden base.

The levelling screws may be of any form. The heads should preferably be milled, and the ends rounded, so as to avoid scratching the surface of any polished table, etc., on which the instrument may be placed.

The galvanometer being completed, perhaps a few words as to the manner in which it is used will not be amiss.

Referring to Fig. 6, a current sent from C to E would give nine turns, acting on the needle, three of the twelve being neutralised by the three in the opposite direction between C and D.

The resistance of these coils is almost negligible, so that by using the various terminals effects can be obtained from three, nine, or twelve turns, without appreciably varying the resistance of the circuit.

The 320^w coil is joined to the middle brass block and to B. If a plug is inserted in the left-hand hole, the end of the coil joined to the middle block is connected to terminal A direct. Without the insertion of this plug, however, an additional resistance of 750^w is left in the circuit, and the resistance between A and B is $1{,}070^w$.

The resistances are arranged for use with a Daniell cell of a comparatively low resistance, and if such a cell be joined to A and B, the current would be equal to $\frac{1{\cdot}07 \text{ volts}}{1070 \text{ ohms}}$, or ·001 ampere, viz., 1 milliampere.

If a current to be measured is very strong, a very high deflection will be the result, and to obviate the difficulties which would arise, the current is "shunted," or provided with a second path, so that only a portion passes through the galvanometer, the remainder passing through the shunt.

If the shunt was equal to the resistance of the coil, half the current would pass through each; but if the resistance of the shunt is $\frac{320}{9}$ ohms, then $\frac{9}{10}$ of the current will pass through the shunt, and only $\frac{1}{10}$ through the galvanometer.

This is the case in the instrument in question, the resistance being wound in the same way as previously described, and also placed beneath the base. The shunt is brought into play by inserting the right-hand plug.

Suppose a current of 1 milliampere gives a deflection of twenty-seven tangent divisions. If the tenth shunt is then inserted, and a deflection of eighty-one divisions obtained with a current of uncomputed strength, the current flowing round the galvanometer is evidently three milliamperes, but as this is only $\frac{1}{10}$ of the real strength, it follows that the total current is thirty milliamperes.

I do not profess to have explained the theory of, or more than touched upon the method of, using the tangent galvanometer, and have no wish to trespass upon the domains of our electrical contributors; but persons unacquainted with its use will not require to make it, and those who do understand it are not in want of any explanation. The coils requiring to be of a specified resistance should be tested carefully by means of a Wheatstone bridge.

In a future paper I hope to show how a simple bridge may be constructed.

OUR GUIDE TO GOOD THINGS.

4.—The Britannia Company's No. 8 Fret-Saw Machine.

From the time of its introduction the Britannia Company's "No. 8" machine has been a favourite one with fret-cutters who could appreciate its numerous good features. The makers have, however, not been content to rest on their oars, but have, from time to time, introduced improvements as they have been suggested, till the "Improved No. 8," as the newest form of the machine is called, is as nearly perfect as possible. All the chief points of the original, the heavy driving wheel, large table, equal tension of the saw with perpendicular action, etc., have all been preserved, so that in general the machine remains much as it was. Closer examination, however, shows that there are several well-thought-out improvements, which cannot fail to be appreciated alike by the novice and the experienced worker. Comparing the present with the original machine, the vertical drill, in addition to the one at the side, is the most prominent feature which attracts attention, but, beyond this, there are several minor improvements which conduce to the comfort of the worker. Perhaps the most important of these is the facility with which the saws can be fitted, as the fumbling which so often happens to fit them into the clamps is done away with by a very simple expedient, which allows them to be fixed with the greatest ease. The tilting arrangement has also been simplified, while the saucer-like receptacle for sawdust underneath the table, where it was sometimes in the way when fastening the saws, has been done away with. The stroke of the saw has been increased, as has likewise the distance between the table and the upper arm of the frame. This by no means exhausts the list of improvements; but the others are of comparative unimportance, although they all tend to make the machine what I consider the best both for amateurs and cabinet makers who do not require to cut anything over, say, $\frac{3}{4}$ in. thick, though, as an experiment, I have cut oak of considerably more. It almost goes without saying that the thinnest material and the finest saws can be used, when necessary, with equal facility. The price of the machine complete is 65s. I understand that the makers are contemplating a lathe attachment, which will be a great advantage to those fret-cutters who wish to do the small turned parts which are so often found in fretwork designs. When this is ready, no doubt I shall have something to say about it; meanwhile, readers who desire to know more about it cannot do better than apply to the Britannia Company direct.

5.—Some Useful Books, etc.

The Amateur.—I have received the *Amateur* for March, 1891, published by Messrs. Henry Zilles & Co., 24 and 26, Wilson Street, Finsbury, London, E.C. It contains a very good pattern in fretwork for a bracket and towel-roller combined, which seems a somewhat incongruous bringing together of the drawing-room and back kitchen or scullery, for the towel-roller would not be wanted in the former apartment, and an elaborate bracket above the towel-roller is clearly a waste of ornamentation in the latter. The part also supplies an excellent design for an inlaid table in olive wood, curled walnut, and rosewood.

Development.—This handy volume on an important branch of photography, written by Mr. Lyonel Clark, C.E., author of "Platinum Toning," forms Vol. V. of "The Amateur Photographer's Library," published by Messrs. Hazell, Watson, & Viney, Limited, 1, Creed Lane, Ludgate Hill, London, E.C. It includes instructions for the use of eikonogen as a developer for instantaneous work and a comparison of developers.

The Electro-Platers' Handbook.—Our friend Mr. George Edwinson Bonney, who by this time is well known to all readers of Work as an authority on all matters connected with electro-metallurgy and kindred subjects, has written this volume of Whittaker's Library of Arts, Sciences, Manufactures, and Industries, published at 3s. by Messrs. Whittaker & Co., 2, White Hart Street, Paternoster Square, London, E.C., "to meet the wants of amateurs and young workmen desiring a practical manual on electro-plating at a low cost." It is written in Mr. Bonney's careful, painstaking, and explanatory style, and cannot fail to answer the purpose that he has in view.

Ventilation.—This is a thoroughly practical and exhaustive volume on the important subject of ventilation, written by Mr. William Paton Buchan, R.P., Sanitary and Ventilating Engineer, author of "Plumbing." It is, as it purports to be, a complete guide and text-book to the practice of the art of ventilating buildings, and contains instructions on air-testing, giving various methods of examining the air of buildings. It is published at 3s. 6d. by Messrs. Crosby Lockwood & Co., 7, Stationers' Hall Court, Ludgate Hill, London, E.C., and forms a volume of Weale's Rudimentary Series.

The Editor.

SHOP:

A Corner for Those who Want to Talk It.

*** *In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

II.—Questions Answered by Editor and Staff.

Furniture Colouring.—W. N. (*Sheffield*).—I am afraid you are not such a careful reader of "Shop" as you say you are, or you would have seen not very long ago an answer to a correspondent on the same subject. As your signature is somewhat illegible, and I cannot turn up the inquiry then answered, I am unable to say whether it is not the one you refer to as having been lost. You know it is really impossible to give answers to questions at once, as the "Shop" columns are limited in extent. It is not worth while repeating remarks so lately given, so I can only briefly answer your present inquiry. Take the colouring of your walls, and paint your furniture similarly. The more colours you use, and the more pronounced they are, the greater the liability to failure. Low tones or light, almost white, colours are generally the most successful. Without knowing something of the prevalent colours of the room in which the furniture is to stand, how is it possible to advise you on what will be best either from Aspinall's or any other paint-maker's cards? If you use white polish, it will not affect the colour; but, of course, if you use dark polish, the colour will be modified accordingly. Get a machinist to do what is necessary to your lathe. I do not think you can do it yourself.—D. D.

Stove and Fret Saw.—Artist in Wood.—Your stove seems practicable enough, as it does not differ essentially from many now in use. It it just such a thing as anyone who has to do sufficient veneering to make it worth his while to have a special stove for heating cauls could construct or arrange for himself. No doubt you know that, in ordinary circumstances, the usual open fireplace is quite sufficient. I am sorry to say that I am so dense as to be unable to make head or tail of the description of your new form of scroll saw. Therefore, to say that it is very good would be flattery of the most senseless kind; while, on the other hand, to say that the idea is worthless, might possibly be the means of discouraging you, and preventing what may be a really good thing from being brought forward. To go into all the parts which I do not understand would entail too much time, but if your invention has got further than paper, and a machine has been made on the lines you dimly suggest, let us have a description in which the blanks of your present one are filled up. Such little omissions as source of motive power, disposition of top end of saw, and one or two trifles of that kind, do not exactly help one to understand your meaning. Life is too short to spend many days in trying to work out a mechanical puzzle of the kind you put before us.—D. D.

Polishing Alabaster.—Monumental Mason.—This is an inquiry for "full details," and yet there is no indication, except, perhaps, the signature which points to carved doves, whether the work to be polished is flat, turned, or carved. Space is too precious to go into all the tools and methods employed, so the following summary is submitted with the hope that it will give the information required; if it does not, then write again. I will suppose that the work has already a good smooth surface left from either rifflers, scrapers, or glass-paper. Now use some fine sand-stone or grit-stone, such as robin hood, water of Ayr, or snake-stone, or else trent sand and water, until you get rid of all tool marks; follow on with pumice, either in lump or powder, also with water; next use putty powder and water, and for a finish I am told soap and water is particularly good to use with the putty powder, especially for lathe work. As to the way in which you will apply these materials, that must rest with yourself, as I have no details to guide me. If for crevices in carvings, a soft stick will best hold the polishing powder. For choice, get some dog-wood—that is, what butcher's skewers are made of. Then for other forms, buffs of leather, pads made of cloth, either to use by the hand or to revolve in the lathe, or dollies of wool or list, also for the lathe, may be required, while the hand itself may be used to give it an extra finish.—H. S. G.

Bird Cages.—A. T. (*Inverness*).—There are probably few readers of Work who do not keep a canary or a bird of some kind, and perhaps some of them would like to see their songster in a large cage. I will give instructions how to make a cage—a cage that is roomy, ornamental, and not difficult to make. The one illustrated (Fig. 1) is a square cage, standing upon a table. The eight uprights are of ¾ in., and the rest is of ½ in. mahogany. The top is in one solid piece, with a round hole cut for the dome. After the wiring is done in the bottom part, the top is simply glued on the eight uprights, as in Fig. 4. To wire the dome, divide round the circle with a compass ½ in.; for the top of the dome, have a round piece of mahogany; divide that into the same number of parts; bore the holes, then cut a number of wires the length, to give the dome a pleasing curve; fasten a wire in the bottom and in the top piece, and bend it to the proper shape; then put one in each corner; and now go all round, bending each wire. For binding and straightening the wire, see page 20, No. 54, Vol. II. of Work. A simple breeding cage, if it is wanted to hang in a large room for the season only, could be made of ⅜ in. pine, put together as in the drawing (Fig. 2). There is no pretension to ornament: it is a simple

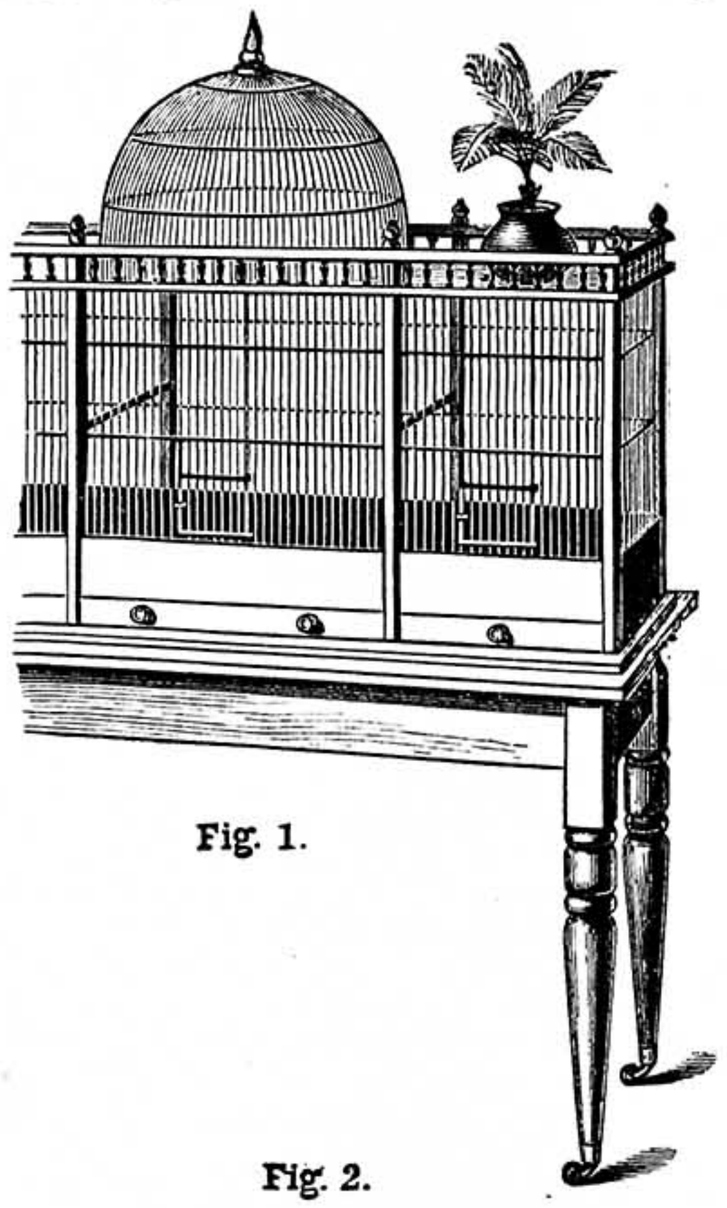


Fig. 1.

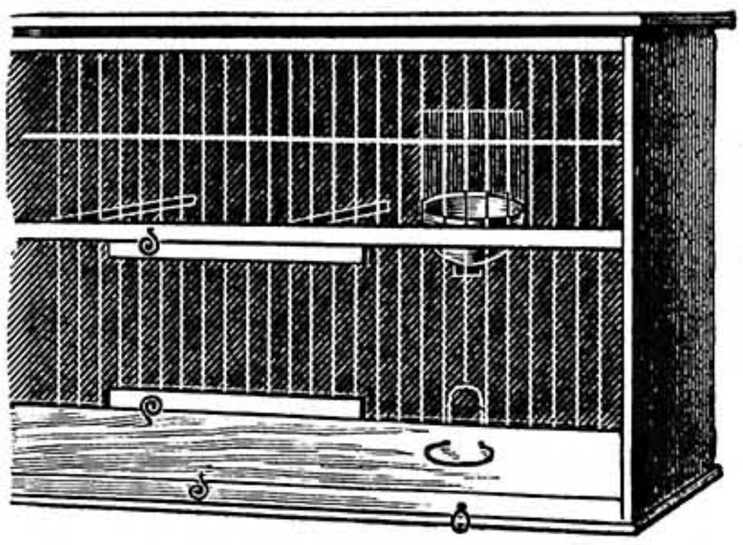


Fig. 2.

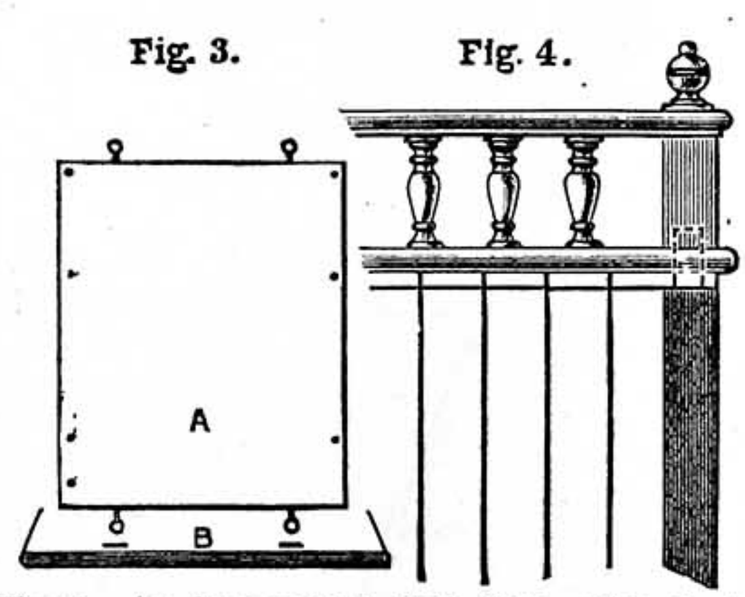


Fig. 3. Fig. 4.

Fig. 1.—An Ornamental Bird Cage. Fig. 2.—A Simple Breeding Cage for Canaries. Fig. 3.—A, End, and B, Bottom of Breeding Cage that can be taken to Pieces. Fig. 4.—Mode of fastening the Top on.

square cage that any novice might knock together. Fig. 1 is also an easy cage to make, and anyone with a little knowledge of carpentry could make it. I have several cages that are made to take to pieces after the breeding season, and can be stowed away in a small space. They are often on the plan of Fig. 2, but I should not care to keep the birds all the year round in a deal cage. I will now describe how to make a simple breeding cage. List of pieces required:—Two pieces for top and bottom, 21 in. by 11 in.; two pieces for sides, 14 in. by 10¾ in.; one piece for back, 23 in. by 10¾ in.; one piece for false bottom, 23 in. by 10⅜ in.; for front, three strips, 23 in. by ½ in.; one strip, 23 in. by 2 in. Plane all these pieces both sides, and before putting the cage together, stain and varnish the outside and white-wash the inside. Now mark the pieces for the wire, ½ in. apart; you can do this with a rule or a stiff compass, but if you are making several cages, it will save time if you make a marker, as described in Work, No. 54, page 20. You can bore the holes in soft wood with a bradawl; take care to have it sharp, and cut across the grain; bore holes right through on strip of ½ in., and half-way through the others; cut one of the ½ in. strips into two pieces, 5 in. long, for the door, and put the door together with seven short wires. Having bored the last hole right through, and shaved the other ends so that the door will shut flush, put the wires through the centre strip, and get them all level; get the top strip on next, beginning at the end; pinch each wire with the pliers, and give the pliers a slight tap; leave out seven wires in the centre of the cage for the door, and put the door on the eight wires; cut about 1½ in. off the seventh wire from each end of the cage for the food and water fountains; turn up, and drive the wires into the bottom strip, taking care that they are parallel. Bore holes, and put the wire in for the fountains, and take care to fasten the ends in well; cut a slant for a feeding tin. Now the front is ready: nail the end on the back and front, then the bottom, and lastly, the top and the front strip on to the false bottom; make the fastenings for the door; fit and fix the perches in. The drawings will assist the amateur to make a simple breeding cage. There is a very good nesting basket described in Work, Vol. II., No. 95, page 699, which I have found to answer the purpose; such can easily be fixed to the back of the cage.—F. H.

Spokes.—Wood-Worker.—First get your spokes for the heavy cart dressed off. When the hub or nave is turned, you will see that the wood-turner has marked a line with his chisel. This guide-line is nearer to the front than the back. When marking and driving home the spoke in the nave, the face of the spoke at the bottom must be in a dead line with this guide-line. If the wheel has twelve spokes, we divide the nave into twelve equal parts with a pair of compasses 1 in. behind the guide-line; when found, mark the division well by digging the compass-point well in the nave. Next, fix the nave in the pit-frame, and bore half-way through with a 1 in. bit at every mark or division. In boring, always have the bit perfectly perpendicular. When all are bored, get a dressed spoke and place the tang or foot of it just over a hole, and the face of the spoke in a dead line with the guide-line, and let the spoke be placed exactly between the other two holes at each side of the spoke; next run your pencil round the two sides and the back, thus marking the nave. We now pare this mortice out within the lines, and drive in the spoke, using a spoke-boy or stick set right to guide us in driving the spoke in properly. We now miss a mortice, and go on to the next and serve it in exactly the same way as we did the first; thus six spokes are driven in alternately, leaving a space between every two spokes to receive another after the first six are in. If all the spokes were driven in one after the other, the consequence would be that the nave would burst into halves. In light wheels, the spokes are dressed off differently from the cart fashion, and are driven in the nave on the on and off system alternately; therefore two guide-lines are turned upon the nave, the off guide-line being ½ in. behind the on or front guide-line. The strength of the timber for a heavy cart wheel is generally as follows:—Oak nave or hub, length 15 in. by 13 in. (in 6 in. wheels the spokes of English oak are 4 in. by 2 in.); felloes of ash or oak, 6 in. by 4½ in.; hoops or tyre, 6 in. by ¾ in. thick; height of wheel when finished, 4 ft. 9 in. In 4½ in. heavy cart wheels the strength of the nave is the same; the spokes are 3½ in. by 1¾ in.; felloes, 4½ in. by 3½ in. or 4 in.; tyre, 4½ in. wide, ¾ in. thick; height of wheel when finished, 4 ft. 6 in. or 8 in. The strength of timber for wheels for a light trap is: nave of elm, 9 in. by 8 in.; felloes of ash, 2½ in. thick; oak or hickory spokes, 2 in. by 1¼ in. thick; tyre, 1¼ in. wide, ¼ in. thick: the lengths of the spokes go according to the height of the wheel. A pair of wheels suitable for light spring-cart for a pony of thirteen hands would be about 4 ft. high.—W. P.

Platinum.—J. W. (*Homerton*).—Write your wants fully to Messrs. Johnson, Matthey & Co., Hatton Garden, London, E.C., who will doubtless reply to you.

Silvering on Glass.—W. E. L. B. (*King's Norton*) from information given in Work has succeeded in silvering glass in the ordinary way; he now asks information on chemical silvering. May I ask if W. E. L. B. intends to work simply experimentally or on a large scale for profit? If the former, I think I can help him; if the latter, something more than information will be needed. I have never had occasion to silver by this process, but I have secured information from a reliable source which I am pleased to impart to the inquirer. There are several processes; the following I give with confidence. *Silvering Solution.*—Dissolve forty-eight grains of crystallised nitrate of silver in 1 oz. of distilled water. Add strong liquid ammonia drop by drop, stirring

at the same time with a glass rod—the stirring must be continued until the brown precipitate is nearly, but not quite, re-dissolved. It must now be filtered and distilled, and water added to make up to twelve fluid drachms. *Reducing Solution.*—Dissolve twelve grains of Rochelle salt in 1 oz. of distilled water. Boil in a flask, and whilst boiling add two grains of crystallised nitrate of silver dissolved in one drachm of water. Let it boil five or six minutes after the latter has been added. Filter when cold, and add distilled water to make twelve fluid drachms. *Silvering.*—The glass to be silvered must be *chemically clean.* To secure this, dip it in strong nitric acid. Then wash in liquor potassæ, and finally wash in distilled water. To have the glass approximately clean is not enough. Chemicals are very particular as to what company they keep, and positively refuse to act unless they are consulted. In a glass vessel of a size suitable to the glass to be silvered, equal portions of the two solutions must be poured, and stirred so as to be intimately mixed. Previous to this, some plan must be devised by which the glass can be gradually lowered into the vessel. For example, a piece of wire may be cemented to the side of the glass not to be silvered, and be made to pass through a hole in a piece of thin board; this may be placed across the mouth of the vessel; the glass attached to the wire can then be raised or lowered. The glass, whilst still wet from the bath in distilled water, must be let down into the solution. The utmost care must be taken that the entire surface touches the solution without any air-bubbles between. The vessel must be set in the sunshine in a warm room. The light soon turns the fluid black, which gradually grows clear as the silver is deposited. It must at this point be removed, for if left after the solution is exhausted, the silver will be partly re-dissolved. When the mirror is removed from the bath, it must be carefully washed in distilled water and placed on its edge to drain and dry. When perfectly dry, the silver must be varnished with an elastic varnish or paint to prevent damage. I shall be pleased to give further details if needed.—O. B.

To Soften Gold.—H. H. W. (*Pimlico*).—To soften gold or silver after hammering, all that has to be done is to anneal it—that is, make it red hot, and let it cool or quench it in water, when it will be as soft as ever it was. Experience will teach you that the heat should be applied regularly, gently, and gradually; that to make the part near a soldering seam hot first of all will cause it to open; that a sudden quenching is bad. These, and many other things, will be found out by experience, for on the application of heat for soldering and annealing, one of our foremost jewellers (Giuliam of Piccadilly) says that it takes an apprenticeship of seven years to master. This applies only to the work if of good size and of complicated design. For every-day work, no difficulty is likely to be experienced.—H. S. G.

Silver Foil.—CAROL.—This preparation is generally believed to be a French production, and from experience with it in the workshop as a finished article, I should say that it would be a very difficult matter to keep the thin silver flat, smooth, and bright while the paint—which I believe is put on when warm—is being evenly applied. You might make inquiries at the flatting mills (Buckland Hop Gardens, St. Martin's Lane) as to the thinness they can flat silver to; if too thick, then try a gold beater. When you have got your silver thin enough, you have to find somebody to burnish it. The next thing will be to obtain the paint. All I know about that is, that it can be bought at jewellers' material shops in various colours—named after the stones. Of its composition I have never thought, but rather suspect if I really wanted to know that, I should get a chemist to analyse some. The foregoing is merely an indication of what I think is the manner of proceeding. The game can never be worth the candle. If, however, you intend going in for it in large quantities, no doubt the Editor will put a query at the end of "Shop," and I will as well spend some time in going into the matter, if you will but write again.—H. S. G.

Angle Iron.—W. C. (*West Bromwich*).—The iron mentioned in answer to A. S. (*Forest Gate*) is not *angle* iron, but iron of "rectangular" (oblong) section. I do not think you can get angle iron so small, but upon this point you could get information from any manufacturer of iron bedsteads. I believe they use the smallest angle iron rolled.—F. C.

Staining and Polishing.—L. G. (*Middleton*).—To stain your light wood chest of drawers a nice mahogany colour, darken it first with a weak walnut stain, and then finish off with French polish, reddened with a little Bismarck brown. The work connected with the polishing is done exactly as if you were treating unstained wood, but it may be necessary to remind you that if the staining raises the grain, as it probably will, you must rub down with fine glass-paper. If you prefer to use a ready-made mahogany stain, you can buy one at almost any oil shop.—D. D.

Book on Joinery.—E. W. C. (*New Wandsworth*).—Joinery and cabinet-making are distinct trades, and the details, etc., given in books are, properly speaking, examples, and not working drawings. You would find Tarn's "Carpentry and Joinery" (2 vols.), published by Crosby Lockwood and Co., 7, Stationers' Hall Court, London, E.C., very useful. "Drawing for Cabinet Makers," by Davidson, published by Cassell & Company, Ludgate Hill, E.C., is also a very good book.—E. D.

Gun Rack.—J. H. (*Lancashire*).—This simple device should be found satisfactory accommodation for three guns and cartridges, unless you object to having their muzzles pointing nearly horizontally. The thicker the side brackets are the better—even 1¾ in. or 1½ in. would not be too stout. Connect the ends of a back rail to the brackets after some such method as I show in Fig. 3. You must have noticed sufficient details elsewhere, applicable to the construction of the cartridge compartments, which I advise you to have as a box, with lid, in preference to drawers. To retain the guns in the position shown, it will be necessary to have hook-shaped

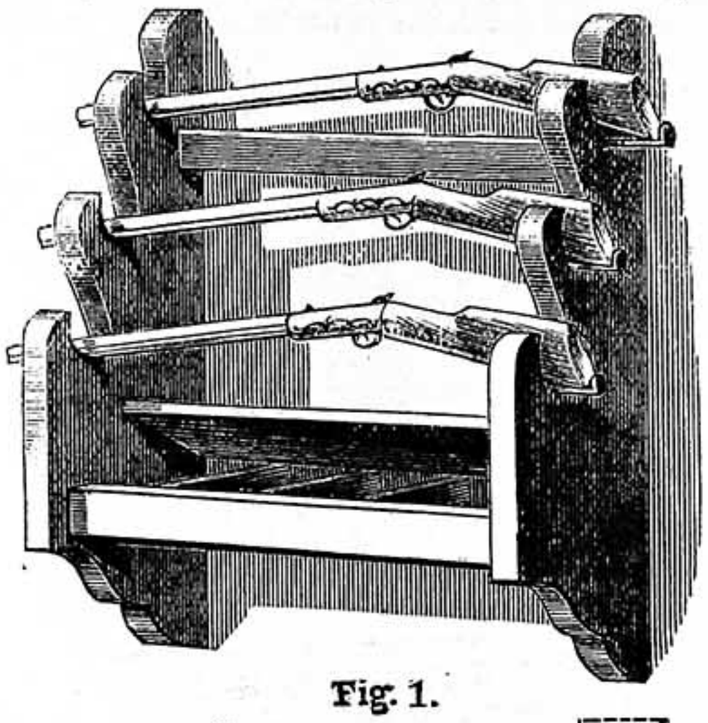


Fig. 1.

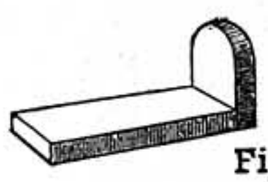


Fig. 2.

Fig. 3.

Fig. 1.—Gun Rack. Fig. 2.—Gun Stock Support. Fig. 3.—How to join Back Rail.

rails, as in Fig. 2, joined to one side of the article, against which will rest the stocks. By placing the guns as I show, their triggers will be less exposed to contact with coat sleeves, when a gun is being taken from the rack, than if stowed each flush with the other.—J. S.

Concrete.—H. A. H. (*Manitoba*).—(1) Concrete is made of four parts of broken stones, made to pass through a 2 in. ring, two parts of fine gravel or coarse sand, and one part of Portland cement. These must be measured in a box without top or bottom, and laid on a platform of boards, and turned over with shovel and pickaxe till thoroughly mixed;

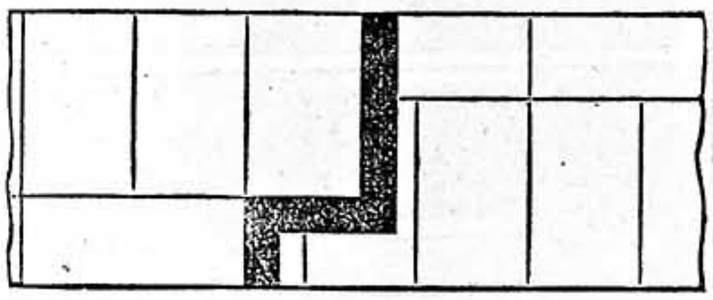


Fig. 1.

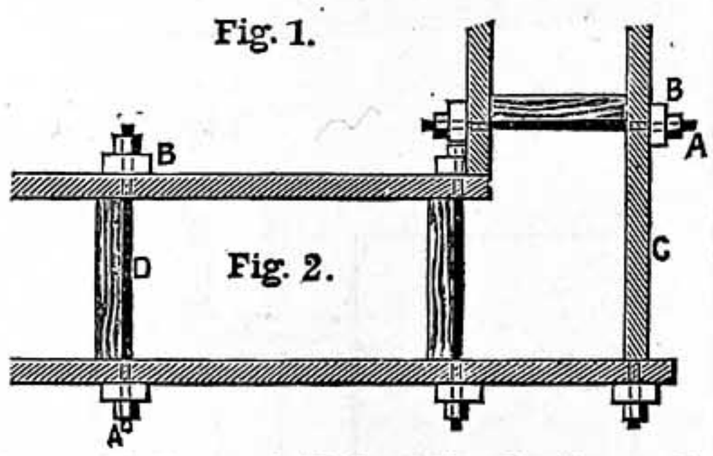


Fig. 2.

Fig. 1.—Binding of Wall. Fig. 2.—Frame for Concrete Building.

then sprinkle water on, and turn over till every part is wetted, but not saturated; it is then fit for use. (2) Walls 16 feet high can be built with it, and if all the moisture is dried out of them, they will not be affected by frost. Should there be any moisture left in, the frost will crack it, but to what extent can only be learnt by experience. If any concrete has been used in the district, you could note the effect of the frost upon it. If you have six months of dry weather after being built, the concrete should be dry. If the climate is wet, you might mould the concrete into blocks—say 12 in. by 6 in. by 3 in.—and wall them as ordinary bricks, binding them as in Fig. 1. For these the concrete must be screened through a ¾ in. screen. (3) The method of building in concrete is by frames 12 in. to 18 in. deep, kept apart by pieces of wood, and a row of ½ in. bolts 3 feet apart at the top and bottom. Washers or iron plates should be put on at the outside, and battens on the outside of the frame, which may be of 1 in. boards. The frame is filled with concrete, and when sufficiently set, the frame is moved along, and again filled, and so on round the building. Then commence a second course, and carry it round in the same manner. When the bolts pass through the concrete, lay a piece of board at each side, to prevent the concrete adhering to the bolts. The holes can be filled up afterwards. Fig. 2 shows the frames. For building flues, use a round core, 10 in. or 12 in. in diameter, with a handle on the top; fill round this with concrete, and, when set, draw the core up. Window and door frames are walled in, a board being fixed at each side of the frame to fill out the thickness of the wall. Two frames will be enough, except for a very large building. After the walls are up, render and float them inside and outside with Portland cement mixed with three times its bulk of sharp sand. (4) The outer walls may be 16 in. or 18 in. thick, and the inner walls 10 in. or 12 in.—M.

Smelting Furnace.—J. G. N. (*Manchester*).—A drawing of such a furnace is given in Bloxam's "Metals," page 314.—J.

Colouring Gold Chains and Whitening Silver Ones.—NEW SUBSCRIBER.—Your best plan will be to send both sorts to a gilder to be renovated, for there are many considerations that govern the use of the following methods, the chief being the qualities of the gold and silver that are to be coloured or whitened. For colouring, you will find all the details given in a reply to YOUNG AMATEUR in No. 19 of WORK, page 301. If the gold chains are not worn, but only discoloured, you can restore them by laying them in a mixture of chloride of lime one part, water ten parts. Afterwards rinse well in hot water and dry in warm sawdust. Neither of these methods to be used for any quality under 15-carat gold. To whiten silver, neither of the two following methods are to be tried on anything less than standard silver, and they only give good results at the first attempt when the silver is fine, such as is used in filigree work. Cover the work over entirely by the aid of a brush, with borax ground up with water on a piece of slate until it is as thick as cream. Then make it red hot, and drop it into a clean warm solution of vitriol one part, water about thirty parts. If it does not come out white on the first application, repeat the process two or three times. Another way is to cover the work with powdered charcoal and powdered saltpetre, mixed together with water in the proportion of three or four of the first to one of the last. Then anneal and boil out in the vitriol pickle given above, or else make this solution in its place: bi-sulphate of potash one part, water ten parts, and clean your work in that. After either of these, the work must be well rinsed in hot water previous to being dried in warm sawdust. To scratch-brush you can use soap and water, but diluted beer is better. Perhaps this method will do what you require: Take a piece of cyanide of potassium about the size of a lump of loaf sugar and dissolve it in a half-pint of warm water, then immerse your chains for a few minutes until the tarnish has gone off, then rinse, etc. To clean them only, an easy method is to apply whiting moistened with ammonia diluted with at least an equal quantity of water, using a soft brush. If you are thinking of trying any of these, first examine your work to see that there is no pewter solder on it, and in the case of gold there must be no silver solder about. It is safest to do as I advise at the beginning of this reply—send them to the gilder. Your signature is evidently a correct one, or else you would have seen that Mr. Bonney has a series of articles in this paper dealing with the subject of electro gilding.—H. S. G.

Power of Water delivered through Pipe.—GOSFORTH.—This must be treated by a formula for the flow of water through pipes, and the head will be a plus d, assuming that no tank intervenes. To ascertain the power, we must calculate the discharge at the delivery point, and the *work* accumulated in the water at that point. This will be best shown by an example. Let a=10 ft.; d=50 ft.; y=100 ft.; and x=2 ft. The total head $h=a+d$=60 ft. Then if Q=cubic feet of water discharged per minute, we find by Downing's formula:—

$$Q = 2{,}356\sqrt{\frac{h}{y}}\times x^5 = 2{,}356\sqrt{\frac{60}{100}}\times 2^5 = 10{,}270 \text{ cubic ft.}$$

One cubic foot of water weighs 62½ lbs., therefore the *weight* of water delivered per minute will be $10{,}270\times 62\frac{1}{2}=64{,}185$ lbs. As the pipe is 2 ft. in diameter, its area is (from a table of areas) 3⅛ sq. ft. Dividing the quantity by this, we find the velocity per minute $\frac{10{,}270}{3\frac{1}{8}}=3{,}423$ feet per minute =57 feet per second. From the laws of falling bodies we find that the accumulated work in a body is equal to the product of its weight and the square of its velocity in feet per second divided by 64⅔. In this case it equals $\frac{64{,}185\times(57)^2}{64\frac{2}{3}}=32{,}381{,}000$ foot-lbs. per minute. Now one horse-power is equal to 33,000 foot-lbs. per minute; therefore the horse-power given by the water will be $\frac{32{,}381{,}000}{33{,}000}=981$ horse-power.—F. C.

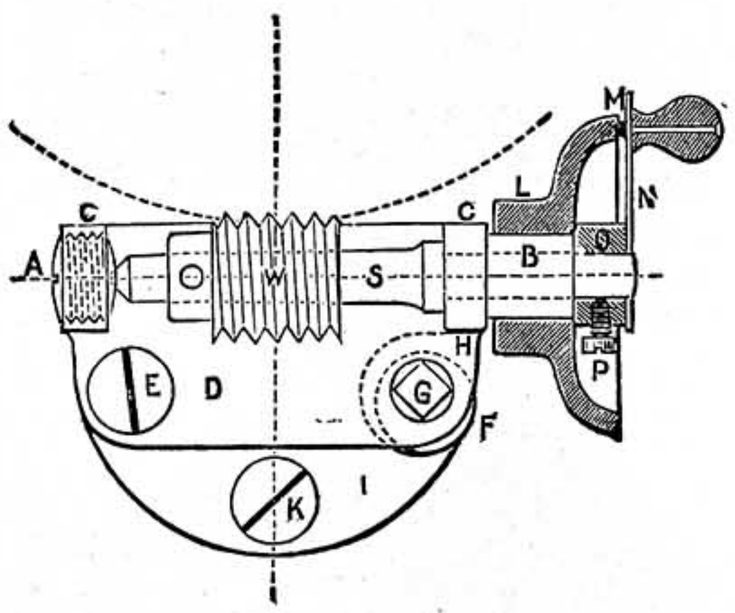
Musical Box Repairs.—SECRETARY.—First you say "pins out of barrel." Do I not tell how to re-pin the same in my article? "Three teeth in comb gone." I also state the best remedy unless you purchase

...ew comb; but three teeth you can insert, as I wrote. ...w, as to working—and being a mechanic the job is ...sier to you—be sure to let it down to the bottom, ...pins and teeth are broken by careless unscrew- ...of the fly-wheel; when spring has great power, off ...ots of teeth and pins. Then do as I say—*clean* ...oroughly; not too much oil, and it will go easy ... well. If not, see to the worm part. This part ... be too far in—"too near its work," as you ...chanics would say. If too far away—why, it ...ould go to the bottom in two minutes or less; this ... remedy by turning the screw from you (only ...quarter-turn, or less) until it works, with pressure ...your finger or thumb on the second wheel from ...arm.—PRACTICAL.

...tslide Painting.—W. J. C. (*Islington*).—First, ... colours used. Most dealers in artists' material ...pply boxes with all needful colours, etc. But it is ... really requisite to procure a box, or, indeed, ...ery colour that may be found in them. The ...owing will be found sufficient for a beginner. ... J. C. doubtless is aware that all colours must ... so-called transparent. *Red*—madder lake, crim- ...lake, pure orange, pure scarlet (this colour has ...en a difficulty, but a few months ago I received a ...e from Messrs. Reeves, 113, Cheapside, London. ... is a new paint, and I am informed that it is the ...ult of much patient experimenting; the colour ...exceedingly good, though it must be confessed ...t an absolutely pure scarlet in transparent colour ...mains to be discovered), burnt sienna. *Yellow*— ...llow lake, gamboge, yellow madder, Italian pink. ...*een*—verdigris. *Blue*—Chinese, Prussian, indigo, ...nch ultramarine. *Brown*—vandyke, madder ...own. (Madder lake and ultramarine are 1s., ... the others from 3d. to 6d., per tube.) Varnishes ... be needed. From W. J. C.'s letter, I fear he ... been working without them, as he says his ...nt rubs off. Mastic, gold-size, copal, and pure ...rpentine, will meet his requirements. There is one ...le omission in W. J. C.'s letter; and that is, he ...es not say if he is working in oil or water. I am ...suming, however, it is oil. Secondly, he asks, "Is ...re any way of putting them on, as I cannot get ...m on even?" They can not only be got on, but ...nly too. I suppose the difficulty experienced is ... large flat surfaces, as the sky. Now, if one looks ...utely at a well-painted slide, he will see that ... sky appears granulated, if I may so say. Some- ...es circular marks similar to "thumb-marks" ... be seen; colour is laid on the upper sky, and ...ought down near the horizon—from the horizon ...wards to meet the blue. Yellow-red (or orange) ...aid according to the effect required. These two ...ours are now blended together by means of the ... of the little finger. The finger makes little ...bs accompanied by a somewhat rolling move- ...nt difficult to describe, but soon acquired by ...actice; by this means the two colours are ...nded in a perfectly even manner. If the colour ...too thin on the glass, then a little is taken on the ...ger from the palette and dabbed on. On the ...er hand, if the colour is too thick, wipe the ...our off the finger on the palm of the other hand, ...peating this until the colour is brought to the ...per intensity and depth. Some workers cover ... top of the finger with the end of a white kid- ...ve, but practical men prefer as a rule to dispense ...th this addition. The last point referred to is— ...at when the paint is put on, it rubs off so easily. ... this I am afraid that proper precautions have ... been taken—first, in the use of proper varnish, ...ch as I have mentioned; and, secondly, the slides ...ve not been stoved in a warm (not hot) oven for ... purpose of hardening the varnish. If proper ...rnish is used and hardened, there is no danger ... the paint coming off. It must be understood ...at the first coat must be perfectly hard before the ...xt is laid on. I have only given the colours as ...ey are procured ready-mixed in the tubes, but it ...ll be understood that any number of secondary ...lours may be made by a proper mixture of any ...o of the colours named. There is another word, ...m afraid, necessary from W. J. C.'s letter in refer- ...ce to the use of a medium with his colours. Mix ...astic varnish ¾ oz., turps, one teaspoonful, and ...enty drops of pale drying oil or gold-size together ... a wide-mouthed bottle, and thin down all paints ...ith it.—O. B.

WORK Binding and Index.—INDEX.—The ...ice of the covers for binding WORK volume is ... 3d., and the Index 1d. of all booksellers. You ...ould do well to have your numbers bound at your ...ookseller's, as the carriage backwards and for- ...ards would be expensive.

Wheel Cutting on "Go-Ahead" Lathe.—INDEX.—If you wish to understand how dividing is ...one by worm and wheel, please read the article on ...age 113, Vol. I. of WORK. This will, I hope, make ... quite plain how you may get any number of ...visions from a given worm and wheel. You wish ... fix a worm-wheel on the tail end of your mandrel, ...nd the worm on the back of the headstock beneath: ...ou might adopt a worm-wheel of 120 teeth, and a ...orm of ⅛ in. pitch = ·125. Multiplying ·125 by 120, ...ou get the pitch circumference of the worm-wheel, ... in.; dividing this by 3·1416, you find the diameter ... be 4·77—say, 4⅞. Now then, having 120 teeth in ...e worm-wheel, one turn of the worm-screw ...etween each cut will give you 120 teeth or ...visions; two turns, 60 teeth; three turns, 40 teeth; ...alf a turn, 240 teeth, etc. Or, according to the ...le given on page 215 of Vol. I., divide 120 by ...e number of divisions you require, and you get ...e number of turns, or the part of a turn, you must ...ve to the screw between each cut. Now you will know that on the end of the screw you can put three different kinds of expedients for counting its revolutions or parts of a revolution; you may have, simplest of all, a divided collar, or a series of exchangeable collars having different numbers of divisions; or, secondly, you can have an index plate, or several plates—a system which is explained in Messrs. Brown & Sharpe's "Milling Machines," to be had from Buck & Hickman, or Churchill, for 6s. 6d.; or, thirdly, you can have a train of small wheels with a click, so arranged as to turn till the click falls into a notch between each cut. The plan explained in Vol. I. is a kind of cross between the two last, and is somewhat simpler than either, and I think it would suit you very well, as you are not continually employed in wheel cutting. The sketch below shows how you might arrange matters. The dotted arc is part of the pitch line of the worm-wheel; W is the worm, S the spindle which carries it; A is the centre screw confining its motion endways (it is made of large diameter, so that the collar of S can be passed through the tapped hole it leaves); B is the place on which the divided collars fit; C, C are the bosses on the plate D; E is the pivot screw which secures the plate D, and round which it can turn when raised into gear by turning the square, G, of the eccentric F; this eccentric bears upon the bottom of a recess H, cut out of the plate I, which plate, I, is secured to the back of the headstock by one or more screws, K, and may remain in position



Wheel Cutting.

even if D and its attachments be removed; L is a collar, of which there must be several; they fit on B by pressure of the hand, and have in their edge a number of shallow holes, into which the ball point M drops, and is held there by the spring N; O is the boss of the spring; it is fixed to the worm spindle in any position by the set screw P. Since you say you wish to cut wheels of from 60 to 80 teeth, divide 120 by every number of teeth you wish to cut—thus, $\frac{120}{60} = 2$, which means you require to turn the worm-screw round *twice* between each tooth. Some numbers, being primes, are very difficult to deal with except by the method indicated on page 215: these numbers are 61, 67, 69, 71, 73, 74, 77, 79. Very probably these numbers may not be required, and for the rest you will require ten collars, divided into 3, 5, 7, 8, 11, 13, 17, 19, 21, 23. These you could easily divide yourself by stepping round with dividers, which would be quite exact enough for the collar.—F. A. M.

Steel Spring.—H. S. (*Chesterfield*).—Your order is a difficult one to fill, especially as you want the springs of different *tempers;* it would have been easier if different *strengths* would have done. I should advise you to write to Messrs. Grimshaw and Baxter, 33 and 35, Goswell Road, London, E.C. I think clock spring will be the best material to use.—F. C.

Hinge.—HELPLESS.—To obtain what you require, you must make or get a spiral spring, which in its length makes one half turn, and in radius fitted to that of the hinge when closed, or it should be rather less, to keep the hinge sides tightly closed. If there is no cavity behind the hinge for the spring to play in, the hinge itself must be recessed. The spring so made is to be firmly fixed by one end to one wing of the spring (the fixed wing preferably), and so set that its free end, after making a half turn, bears firmly against the other wing of the hinge.—F. C.

Wood Background for Carved Panels.—B. A. B. (*Hampstead*).—To obtain the basket-work effect, a punch of this style is sold |||| for hammering the uncarved background. Also, I believe, a triangular one ////. But it is obvious that either of these would yield a set mechanical effect, whereas if an ordinary tool—say, a chisel with a blunt edge—is hammered on (in the rougher way shown in the design), the effect can be obtained more roughly, and, therefore, more effectively.—J. G.-W.

Piano Scale, and Felt on Hammers.—G. T. (*Chatham*).—Your letter is not very explicit. I gather from it that you, having set your compasses to $\frac{6}{16}$ of an inch, 3 ft. 9 in. and 3 ft. 11 in. do not correspond. I cannot understand exactly what you want to know; so I must surmise. In No. 36 of WORK you will find a portion of a scale, actual size. Now, if you make one octave correct to this, and repeat it until you have the seven octaves, I cannot see how you can go wrong; this will be your top scale, the bottom one is contracted 2 in. at the bass end. The top scale is placed at the bottom edge of the wrest-plank when it is used, as this is the strike-line where the hammers strike. If you placed this scale on the top edge of wrest-plank, it would be decidedly wrong. Read No. 36 of WORK with care; it will explain everything you require to know. Of course, if you commenced your piano before you saw WORK, it is impossible for me to know how you made it, and where you obtained your instructions, unless you divulge it. If this answer does not satisfy you, write again and enter into particulars. The longer the letter, the more complete will be the answer. The felt, as you are perhaps aware, is manufactured on the taper; the thick end is placed at the bass, while the thin end extends to the treble. You can obtain this felt in strips—from 1s. 6d. upwards—from Goddard, ironmonger, etc., Tottenham Court Road, W.C. Of course, the better the quality, the better the tone; you can get a medium quality for 3s. 6d. You require a long-bladed shoemaker's knife, and sharpen on emery cloths; this gives an edge suitable for felt. Take the felt off your treble and bass hammer, and see that your felt is not too wide. If you look at the felt you have taken off, you will see that where it is glued on the wood of the hammer the edges are pared down while it is in the length. Now make a piece of wood $\frac{1}{16}$ of an inch wider than the felt you have taken off. Use this as a gauge to cut your felt by. Springs for putting this felt on may be obtained from G. Buck, tool-maker, Tottenham Court Road, if I remember rightly, at about 3d. each. If you wish to do without springs, you can use pieces of very narrow tape to tie with. To take the old felt off, cut through the centre of the felt with your knife, as it is not glued here; then you can tear it off. Having your glue nice and hot, but not so thin that it will soak in the felt, begin at the bass end. Take the first piece of felt, and glue the top side of the hammer only; then wrap your piece of tape round, or put on your spring. Now miss one piece of felt and one hammer, doing every alternate one, till you have got to the treble end; then go back to the bass, and glue those you have missed. The idea of missing every other one gives you more room to put your spring on. Now, having got all these glued on the top side, start at the bass again as before, and glue the under side of the hammer, not the centre. Pull your felt firmly over (you will find it will stretch a little), and secure as before. You must then trim the sides with your knife; and if you have not cut them neatly (as this requires some practice), apply a warm flat-iron to the sides.—T. E.

Boiler Injector.—STOKER.—The apparent paradox of steam leaving one part of a boiler, and not only rushing back into it, but carrying a quantity of water with it—although, on its passage, there is an opening to the atmosphere—may be thus explained. It must first be observed that whereas steam in motion expands in *all directions*, a jet of water moves in one direction only. Suppose we have steam 60 lbs. pressure above the atmosphere; its volume is 380 times that of the water from which it came, and into which it will condense. Then, if it is supposed that steam is leaving a boiler at that pressure through an opening of 380 square inches, and that its speed of motion remains the same, if it is suddenly condensed in passage it will pass through an opening of one square inch. it will remain of the same *weight*, and, therefore, have the momentum acquired from 60 lbs. pressure over the larger area, and being liquid will keep its course in its direction when condensed; so it is easy to see why the condensed steam will jump a break and go back into the boiler, and it is also evident that it will have a great margin of spare energy. Its speed will not increase, for each particle will have its original velocity, but in the condensed form they will close up and act upon less surface—like a few people forming up close together to rush into an open crowd. Now, as for the feed water it takes in, that depends upon the general principle of injectors. If you blow a stream of air through a nozzle into a tube in line with it, its friction against the air through which it passes drags the latter with it and so creates a partial vacuum into which water will flow, and the same occurs with the condensed steam in the boiler injector. This is very old, and a water stream was in remote times so employed to suck in air for a blast at the Cornish mines. If you take a T-shaped piece of glass, open at all ends, and put the stalk in water, and then blow through the horizontal part, you will see the water rise. Barber's sprayers are on this principle.—F. C.

Oven Thermometer.—D. G. T. (*Ilminster*).—An oven thermometer should be procurable for about five shillings. Arensberg, Boar Lane, Leeds, or any respectable scientific instrument dealer, would supply you with one.—QUI VIVE.

Bass Bar.—ALBERT.—Accepting 9 in. as the width across the waist, the position for the bar should be laid out by making two lines, the first 1 in., the second 1½ in. distant from, but parallel with, the centre joint. The dimensions of the bar—speaking generally, of course—are 21 in. long by ½ in. thick by 1 in. deep at the point where the bridge will stand; from this point it should diminish with a slight curve to ¼ in. deep at each end. The "reeds" of the wood should run vertically through the bar, which ought to be 1¼ in. deep when planed up ready for being fitted.—B.

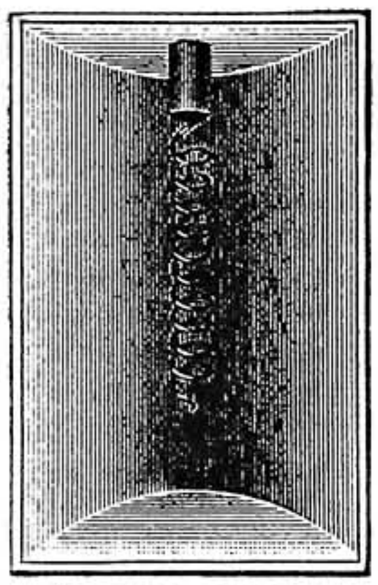
Fairy Bells.—CURLY.—The dimensions given on page 814, Vol. I., are correct. No better wood than pine can be used, as it combines lightness with straight, even grain, and a perfect freedom from

knots. The best kind of varnish to use is hard copal. If spirit varnish is used, although it may be handled sooner, it is not nearly so lasting, and will show white marks if scratched or chipped. But better than any varnish is French polish, which also gives a better finish. The figures given in Fig. 3, p. 814, are 2¼ in.—R. F.

Syphon.—W. B. (*Highgate Hill*).—The term syphon (although generally employed) is hardly the correct one. It would, perhaps, be more correct to say trap. If your meter is lower than the main, you must put in a T-piece close to the meter. Let the T-piece point downwards, and screw a short piece of barrel (about 12 in. or 18 in.) in it, plugged off at the end. This will catch any water that may collect in the pipes, and can easily be unscrewed and emptied at any time. It will be best to call the attention of the Gas Company's inspector to the fact that a syphon is necessary before putting it in.—T. W.

Chromic Acid Cell.—J. A. S. (*Cardiff*).—I cannot understand or explain the erratic behaviour of your chromic acid cells, as I have not experienced such variations as you mention. It would be better to employ a stronger solution, containing 3 ozs. of chromic acid and 3 ozs. of sulphuric acid to 1 pint of water, instead of 1 oz. of each to ½ pint of water. I should suspect a wrong adjustment of the brushes, or a worn condition of their bearing parts, rather than a failure in the cells.—G. E. B.

Magnesium Lamp.—DRY PLATE.—One of the most simple and least costly forms of a magnesium lamp is shown in the annexed illustration. It is made of silver-plated sheet copper to the form shown, and the inside is burnished and polished to a mirror-like brightness. The height should be from 6 in. to 7 in., and the width in front about 4 in. A small brass clip is fixed in the roof of the lamp, and to this the spiral of magnesium wire is attached. The spiral is made out of 6 in. of magnesium wire wound on a thin pencil, then stretched out. It is burnt by means of a small spirit lamp. Some few years ago a gentleman advocated in the *British Journal of Photography* the use of granular magnesium mixed with sand instead of magnesium wire. The mixture was held in a small coned funnel of brass over a spirit lamp furnished with a horizontal burner. When all was ready the mixture was released, and the magnesium took fire as it fell through the flame of the spirit lamp. Perhaps some of our photographic friends can suggest a better lamp.—G. E. B.



Magnesium Lamp.

Booth's Mitre Machine.—J. F. (*Hyde, Cheshire*).—I should think you could get it from any large tool maker, or from Booth Brothers, Tool Makers, Dublin, Ireland.—R.

How to Make a Dulcimer.—TRICHORD.—An article on the above appeared in Nos. 31, 38, and 41 of WORK. The numbers can be had from the publishers, Cassell & Company, London, E.C.; or you can order them through your bookseller.

Steam Carriages.—J. W. (*Belfast*).—You would have no difficulty in getting a steam engine fitted to a road carriage. Its weight will depend upon the power required, and that will be ruled by the steepness of the hills you have to ascend. One of Mr. Yarrow's engines, such as he puts in his "Zephyr" yachts, might suit. They are worked with mineral oil vapour instead of water, and mineral oil is the fuel; they are driven from coil boilers. You might write to Messrs. Yarrow & Co., Millwall, London, on the subject. As to a steam engine, you might write to Messrs. Robey & Co., Lincoln; but in each case state just what you want. An electric motor would be cleaner than a steam engine.—F. C.

Fowls' House.—E. H. I. (*Norwich*).—The sketches show a portable wooden fowls' house, with nest-boxes and perch inside, so that it can be drawn by a horse into different fields when required. Fig. 1 shows the carcase or framework, with 4 in. by 4 in. sleepers (on which the whole is erected, and to the ends of which the wheels are attached); sills, 4 in. by 3 in.; corner posts, 3 in. by 3 in.; heads, cross-pieces, and intermediate uprights, 2½ in. by 3 in.; joists, 4½ in. by 2 in.; rafters, 2½ in. by 3 in.; ridge board, 1¼ in. by 7 in. All the openings, except those left for the nest-boxes, should have braces going from angle to angle, especially as the structure is going to be subjected to great strain by the motion of moving over rough ground. I have left these braces out in the sketch for the sake of clearness. Fig. 2 shows the thing complete, with the exception of the wheels. These can be got at any large ironmonger's, and are readily fixed to the under side of the 4 in. by 4 in. sleepers. The sides are covered with feather-edge boarding, and the nest-boxes with 1 in. matchboarding. All the woodwork should be yellow. The roof is the ordinary iron roofing. Louvre ventilators should be provided, as shown at each gable, so as to ensure thorough ventilation; and the window is also very desirable. The inside of the hatchway in door should have a sliding or hinged flap to be fastened inside, so that when the door is locked you have the fowls under control. The slope should also be hinged or detachable, to save it from injury in moving. The size and position of perches depend very much on the class and size of fowl you wish to keep, and can easily be added to suit your requirements. If you examine Fig. 1, you will see that the construction is very simple, and can easily be made by anyone who can use a few

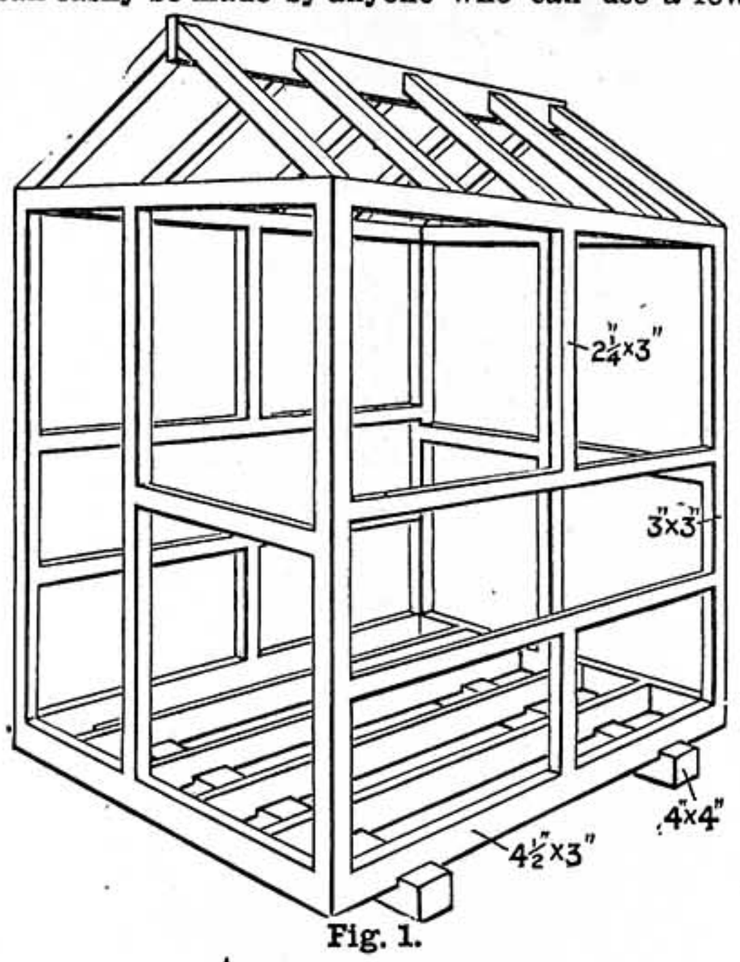


Fig. 1.

Fig. 2.

Fowls' House. Fig. 1.—Carcase or Framework. Fig. 2.—Fowls' House complete.

simple tools; and most of the joints need only be butted together and strongly nailed. The floor boards should be left loose, to enable the whole to be thoroughly cleansed and lime-whited inside from time to time. I have given the size of house as 6 ft. by 8 ft., so you will see it is rather a large thing for an amateur to attempt. The great advantage of the nest-boxes opening from the outside is, firstly, the convenience of taking eggs without entering the house; and secondly, the nests are kept clean, because it is impossible for the fowls to foul them from the perches above. I am not prepared to state what you would have to pay for materials in Norwich, but the best way would be for you to measure up the quantity of each sort of stuff you require, and go to a respectable timber merchant direct, and ask what he would charge. Write to Messrs. Boulton & Paul, Rose Lane Works, Norwich, asking them for a price.—E. D.

V.—BRIEF ACKNOWLEDGMENTS.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—ANXIOUS; A. McC. (*Holywood*); B. and W. (*Sheffield*); INDEBTED; J. S. (*Ipswich*); G. W. (*Bradford*); J. W. M.; DIAPASON; R. O. (*Birmingham*); R. A. D. (*Forest Hill*); W. H., W. E. T. (*Newcastle-on-Tyne*); J. J. (*Lifford*); H. W. (*Strabane*); LEMUR; W. B. B. (*Edinburgh*); W. T. (*Stirling*); B. (*Dundee*); M. E. R. (*London, W.*); A. R. (*Scorrier*); F. S. M. (*United States, America*); HEATHFIELD; D. B. (*Norfolk*); J. W. B. (*Huddersfield*); S. T. (*York*); J. H. F. N.; T. W. A. (*Peckham, S.E.*); K. L. (*Walton-on-Thames*); W. H. G. (*London, N.*); F. M. T. (*Swansea*); M. A. H. (*Richmond*); H. C. (*Lee, S.E.*); A. L. (*London, S.E.*); W. B. (*Camberwell*); F. S. P. (*Shipston-on-Stour*); J. S. (*Govan*); W. H. (*Reading*); ONE WHO FINDS "WORK" USEFUL; FAIT ACCOMPLI; EASTWOOD; J. H. (*York*); WHITE; D. P. V, (*London, S.E.*); THE WYE CYCLE CO; J. S. (*Edinburgh*); HOLLOW-WARE; G. J. W.; ANXIOUS; HOUSE DECORATOR; J. K. (*Manchester*); D. M. (*London, S.E.*); C. C. K. (*Stratford*); A. L. (*Nottingham*); GUM POT; A. J. L. (*Peckham*); FOWL; A. D. (*Cardiff*); PHOTOGRAPHER; A READER FROM THE FIRST.

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